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Devoted to Civil Engineering and Contracting

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Volume 81 July 4, 1918 *Number 1*

Engineering News-Record

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CHARLES WHITING BAKER, *Consulting Editor*

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ENGINEERING NEWS-RECORD

A WEEKLY JOURNAL
DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. Mehren, *Editor* — Charles Whiting Baker, *Consulting Editor*

Volume 81 — NEW YORK, THURSDAY, JULY 4, 1918 — Number 1

American Engineers in the War

TO GIVE the engineering profession some glimpse of the things its members are accomplishing under the stress of war, in the hope that the story of these achievements will inspire others to still greater efforts, is *Engineering News-Record's* purpose in devoting this issue to the engineering work of the war. The subject is so large and many-sided that the scope of our engineers' achievements can hardly be more than touched on in a single issue. Yet it has seemed well to devote one number entirely to war, treating most fully the outstanding engineering development of the year—ship construction—in order to emphasize the important contribution which engineers are making to the conduct of the war, and to visualize for them the tremendous part which the country expects them to play in winning it.

"Contractor" Consolidated With "Engineering News-Record"

BEGINNING this issue there is consolidated with *Engineering News-Record The Contractor*, a McGraw-Hill publication specializing on construction methods and contractors' problems. The publishers believe that by the consolidation they can best serve the interests of the construction division of the field. Charles S. Hill, editor of *The Contractor*, becomes associate editor of *Engineering News-Record* in charge of construction, and will bring to the larger paper his long experience in editorial and construction work, while Fred W. Schultz, manager of *The Contractor*, takes charge of the research and statistical division of the larger organization. By these additions the *Engineering News-Record's* service to the construction side of the civil engineering field will be intensified and broadened.

Inland Waterway Progress Is Slow

CANAL and inland waterway transportation seems to be making heavy weather. Only one waterway has been taken over by the Government and on that operation is hampered by lack of boats. Other rivers and canals, investigated and favorably recommended for Government aid by the Inland Waterways Committee, have been unfavorably reported on by the regional railway directors and are now under investigation by a representative of the Director General of Railways. Barges for the upper Mississippi will be ready next spring; bids on concrete barges for the New York canals have been received, a few steel barges are under construction and a number of old boats commandeered; but traffic has not been built up in general products. Taken as a whole progress has not measured up to the promises of some months ago. Just how badly will the railroad administration feel if the whole waterway program amounts to nothing?

Municipalities Answer Call to Help Win War

AMERICAN cities in their corporate capacity are helping win the war. This is clearly shown by the municipal surveys contributed to this issue of *Engineering News-Record* by twenty-five representative city engineers. Our municipalities are conserving capital, man-power and materials by postponing such improvements as are not necessary to maintain health and essential industries. They are providing utility services, street improvements and other public works needed for war plants. The spirit of service, of municipal and pers nal sacrifice, is dominant. Engineering staffs have gone freely into one or another branch of the Government service, one city engineer department having sent 22 of 23 men. This is the supreme test, the complete proof, of the whole-heartedness of the municipal contribution to the needs of the nation and of democracy against autocracy.

City Engineers Catching Up and Planning for Future

WHILE municipal work is at a low ebb, the municipal surveys published in this issue show that some engineers are bringing records and surveys up to date. Others are planning for the future. This planning ranges from detached improvements to large projects and in the case of one or two American cities to a considerable reconstruction program. Depleted as some city engineer's staffs are, few are so small that some catching up work cannot be done during this period of little new construction. Rarely will it be impossible to do some planning ahead. Where there's a will there's a way. City engineers should show the will and point the way.

More City Revenue from Assessments for Benefits

BESET on the one hand by the demands for war economy and on the other by the need for improvements essential to health and industry, where are our cities to find the money to meet the irreducible minimum of their needs? One source little drawn upon by some cities and fully utilized by comparatively few is assessments for benefits. Further drafts on this resource

were suggested in the address by Mr. Lewis, in the issue of June 27, p. 1223. A merit possessed by assessments for benefits is that they afford an acid test of the demand and perhaps of the ability to pay for several classes of city improvements, more or less local in character. Those who urge the improvement do it knowing they will have to pay the bill. In the report from Pittsburgh, on p. 34, it is stated that demands for local improvements have been above normal of late, notwithstanding high costs. The community is prosperous. Property owners can afford to pay. Where the reverse is true, few demands for paving, sewers, water mains and parks will be made if it is known that the petitioners must foot the bill.

Low Engineering Salaries a Municipal Handicap

DIFFICULTIES arising from depleted staffs are increased, several city engineers report, because of the low salaries paid. If this were due to war economy few would complain. It is not. Instead it is chronic. Not for twenty years, the city engineer of Chicago writes, have salaries been raised in his department—and the city council refuses to meet the present emergency. From Pawtucket comes a similar if not so deplorable a story. To continue such a policy will prove suicidal.

Edgar Marburg—a Loss to American Engineering

AMERICAN engineering has lost one of its most useful members in the passing away of Edgar Marburg. He was not only a good engineer but a good teacher of sound engineering practice. As a structural engineer, he won favorable notice while still a young man, and his studies of cantilever bridge design in particular drew general attention to his capacity for original investigation. In his teaching work he took deep and justifiable pride. He had the welfare of his students deeply at heart and strove to develop to the utmost the latent capabilities of each of them. Teaching was a profession to him, not a mere source of steady income to be earned with the least possible work, and his friends had many opportunities to learn that his own personal test of success was the success of the young men he educated.

It is hard to think of the American Society for Testing Materials without also thinking of Marburg and Dudley, ideal secretary and ideal president. The success of this organization was achieved very largely by the enthusiasm and hard work of these two men, who foresaw the important economic results which would follow the standardization of requirements for the materials used in a large part of American engineering construction. The skill with which they made the path smooth for producer and consumer made them at the same time real pioneers of industrial progress. No work was too hard and no controversies too vexatious to check the enthusiasm of Marburg in his activities for this organization.

Marburg's strong personality and readiness to enter the lists to champion any cause he thought needed a defender developed a number of opponents and a host of friends. Every strong man enjoys a good controversy on a worth-while, debatable subject, and Marburg was engaged in a controversy with one or more friends most of the time. They were educational clashes to both sides, and those who had these mental tilts with Marburg learned to admire his resourcefulness and his fairness. In addition, he had that admirable gift in a friend, silence when not asked for an opinion, and complete frankness, no matter how adverse the criticism, when his opinion was asked. He was truly strong in counsel, earnest in purpose, with high ideals and lovable character.

New Methods Applied to Shipbuilding

APPLYING new methods to an unprecedently new problem, men of many kinds entered into high-speed shipbuilding just a year ago. Shipbuilders, contractors, steel fabricators and lumbermen were among them. In the twelve months since, they have multiplied and again multiplied this country's output until today the United States is by a large margin the greatest shipbuilding nation in the world.

Figures on what is to be done and what has been accomplished up to now are contained in the summary of the Emergency Fleet Corporation's statistics given on p. 40. Two points in this summary illuminate the situation strikingly. The first is that the greatest shipbuilding year in American history, 1901, was surpassed by the single month of May, in respect of ship output, and this in turn will be surpassed by monthly figures half again as large, or perhaps twice as large, every single month into the indefinite future. The second is that we have made our steel industry tributary to ship construction to its full capacity. Every ton of plate production—deducting the necessary boiler and fire-box material and minor uses no less essential—is being devoted to building ships.

The creation of the new shipbuilding was a process very different from simple quantitative expansion. Increased production speed beyond all dreams of former times regenerated the old shipyards. In addition, a new kind of shipbuilding planned on an immense scale and equipped with new ideas and new processes came into being.

Why this just-created industry is new, and in what way the men who took it in hand drew upon peace industries for their tools and methods, is reflected in the story of the Hog Island ship design recounted on p. 4 of this issue. The processes summarily sketched in that article succeeded in putting thousands of hands to work at the most vital behind-the-lines occupation that we have. Without this reinforcement of the shipyard army, shipbuilding in all probability would have remained hopelessly inadequate in quantity.

Resourcefulness and adaptability were displayed in this new development to an admirable degree. In recent issues *Engineering News-Record* has outlined the machinery employed for erection at two of the emergency shipyards, equipment which embodies new conceptions of shipyard method, fitted to the conditions confronting the builders. Casting aside tradition, engineers grappled with the problem of shipbuilding on the basis of knowledge gained in other steel construction. The same spirit and equal resourcefulness were displayed by the men whose task it was to make

the bridge shops serviceable for ship fabrication.

In the magnitude and the many-sided variety of our emergency shipbuilding, it is easy to overlook the fact that two separate agencies are responsible for high speed of construction: standardization, and the massing of enormous productive resources on the problem through the joining of bridge shop and shipyard. Shop fabrication no doubt occupies at the moment the place of prime distinction. Since it will produce half our output when the maximum rate is reached, it is the magic means of doubling the greatest results that we could accomplish without its aid. But the future also deserves consideration, for the rank of leading shipbuilding nation will not be taken from us, for many years at least. The ships of the future will doubtless be fabricated at the shipyard itself. Standardization, on the other hand, will retain its importance. It is to be hoped that the conditions of the past—which created a new type, new form and dimensions, for every new ship—have been outlived. The cargo-carrying service of the standardized vessels now being turned out is likely to give a convincing showing against the custom-made ship ideas. Excellence of detail, rapidity of construction, and low cost will be unanswerable arguments for standardized ships.

In forecasting the future from the present, however, it is necessary to be keenly appreciative of the fact that building at high speed does not necessarily mean building at low cost. All of the ship construction now going on has been planned for speed and nothing but speed. To cut the time of building a ship from six months to three months, any expenditure is justified under the stress of war need. After the war, cost competition will quickly force us back to the basis where economy is the decisive factor.

Of our present methods, only so much can survive permanently as serves economy and speed of construction jointly. Balancing plant cost and labor charge will again give rise to close study. Though we will not go back to the shipbuilding of former times, the lessons learned under the present tremendous pressure will remain chiefly in the form of greater standardization.

The Nation at War

WE HAVE stumbled. We have halted. Even today some obviously necessary things are undone. But, by and large, we are proceeding in a manner worthy of the manhood and resources of this country.

Our first year at war was confusing beyond anything in the memory of this generation. Would the nation back the President? Would pro-Germans carry on an orgy of violence? Could we train men fast enough to get into the conflict in time to help? Could we defeat the submarine? Would the strained relations between employers and labor be adjusted and a serious industrial conflict avoided? Would the confusion in Washington cease, would business methods succeed red tape, would the lack of coördination and the jealousies end in centralization and in a clear-cut program, adequately planned, adequately carried out?

How strange now these questions! Some of them we have entirely forgotten. The asking of them and the accompanying criticism was necessary. There still are problems and mighty ones, but the record to date gives us confidence of the future.

TO APPRAISE our various accomplishments in the order of their importance is difficult. The future historian is likely to place second that which we put first—military progress. He will look on our war making as a factor in and an evidence of our national development. From his point of view the great achievement of fifteen war months will be psychological. No one knew in April, 1917, whether our hundred odd million people were in fact one nation, whether we could find a standard to which all would rally. There was disturbing apathy in some sections as late as last autumn. That is at an end now. East and West, North and South are backing the Government. There is criticism of detail—and properly so—but opposition to the war only from scattered and discredited individuals and groups, rapidly diminishing in number. We have found a national purpose. We are a nation. The test is that of great sacrifices cheerfully borne.

But the psychological effect takes on even something of the international. We have become part of the family of nations. We have learned to think internationally, in world terms. Our insular thinking was named as one of the barriers to rapid foreign trade development by Charles A. Stone, president of the American International Corporation, in the *Engineering Record* of Jan. 6, 1917. Many failed to get his meaning, or refused to believe his position sound. Today the thought needs no elaboration, the position no defense. Poland, Roumania, Servia, Mesopotamia, words a year ago, stand now for political ideals, the striving of nations. Even Russia was hardly more than a name for a vast country; now the symbol of a people distracted, in danger of submersion, a people for whom, because of their past suppression, we have a natural sympathy; the symbol, too, of a land of wonderful potentiality being opened to the exploitation of a ruthless power. Economic penetration, also, was but a word to us; we cared nothing about its inevitable political consequences. Berlin to Bagdad—a Kaiser's fancy then—now one of our problems. China—a geographical fact—now a stage upon which we may have to become actors.

What the results of our new attitude will be can, to some extent, be foreseen. Having acquired international sympathies, having shed priceless blood to establish the reign of justice, we shall never retire to our former political isolation and be indifferent about the destruction of a people's liberties by an outside power in any part of the globe. We will have paid too dear a price to abandon that which our sons have died to gain. Our international sympathies and interests will deepen and broaden.

Following upon this international political viewpoint will certainly come an international outlook on business and commerce. The wide extension of foreign trade, with its certain influence on our domestic industrial structure, is certain. Before the war we had a relatively small foreign trade, and while it was enjoying a healthy growth there were severe handicaps—all leading back to our isolated thinking.

Then we had no merchant marine, no banking facili-

ties in foreign lands, meager foreign investments. When the war ends we shall have the ships and the banks, while the sympathy with and understanding of foreign peoples will favor foreign investment—in the wake of which follows foreign trade. Our industries expanded by the war will have great surplus capacity. At the same time we shall be competing with nations bending every effort to recoup themselves from the ravages of war. They will go into the foreign field with a sharper prod than we shall be feeling, and their best brains, served by labor cheaper than ours, will make new and severe demands on our engineering and managerial ability. It will be most assuredly the age of the engineer and the scientist.

BUT these effects are of the future, rather than of today. Where do we stand as to war problems—problems of immediate import?

Successful warring makes demands of fighting men, of materials and transportation, of money. Of these, we may call money and fighting men extra-engineering; they are not primarily the problem of the engineer, though he has the citizen's interest and responsibility in them. Materials and transportation are his affair.

As to these the problem has been stupendous. From a peace-time organization of industry we have had to jump, in a year, into war. One fourth of our productive capacity had to be converted to military uses—and under two very serious handicaps, a railroad system in a sub-normal condition, and a labor supply shortened by the withdrawal of upwards of a million and a half men. The machine put to new uses creaked. Under the best of conditions there would have been difficulties; the strain was severe. But in addition to the railroad and labor-shortage handicaps, executive control was not efficient. The Government had no appreciation of industrial organization and entrusted high places to theorists, while an army organization, lacking in the coördination necessary for the execution of industrial tasks and in knowledge of methods of large-scale production, was allowed to handle work for which it was not fitted. The result was a confused industrial situation, headed by a capital city that was a vertiable madhouse.

But the machine has found itself, the bearings are aligned, the most glaring weaknesses in design are corrected. The red tape is still strong, the coördination is not perfect, but at least the main lines of procedure are on a good basis, and each day sees further improvement. We are getting into production, the necessary industrial adjustments are made or are being completed. Coal still gives worry, so does the railroad situation—and both, be it noted, are under inexperienced heads.

AS TO labor, there is a decidedly easier feeling. Six months ago this was the most serious of problems. Industrial leaders entertained fear of grave disturbances—in fact, there was widespread expectation of trouble in May. The atmosphere even now is not wholly clear, but the attitude of labor latterly has been such that there is confidence that we can compose whatever difficulties will arise. Labor is patriotic, labor is backing the war, labor, better paid than ever for what it is rendering, making demands that are frequently exasperating, is nevertheless going to bear its share of the sacrifices.

Both sides have learned more about each other. The employee has become convinced that, by and large, capital is not profiteering. The employer has studied his men more closely and has been endeavoring to eliminate as quickly as possible conditions against which complaints might reasonably lie. There have been other stabilizing factors—the Government's study of labor conditions headed by the Lind commission; the excellent work of the industrial service sections of the war department, headed by such men as Dean Schneider and Dr. Hopkins; the emphasis placed by the Government on employment methods and on other largely neglected methods of successful management; the conferences resulting in the Taft-Walsh board, and, not least, the tempering of the attitude of the radial labor elements through the spectacle of the terrible results of Russian radicalism. Now additional steps in labor control—it might better be called employment control—are to be taken, while the Government is getting the data to make it decidedly uncomfortable for those whose war profiteering would offer justification for labor unrest.

The labor situation, then, while not solved is well in hand.

THESE are the major lines as the picture now presents itself. In the details one can find much evidence of the work of the engineer and the contractor. Goethals in the Quartermasters' Corps, Hoover in the Food Administration stand out most conspicuously. The construction of the cantonments is still the best single achievement of our war preparations.

Individually, engineers and contractors have given good account of themselves. That they still have much to do is evident. The scientific and engineering brains of this country and its experimental facilities are not yet fully concentrated on war problems. Nor is development separated from production—a separation the need of which the engineer appreciates better than anyone else. Progress in these directions may shortly be expected. Then, and not till then, can we truly say that in this engineering war, engineers have played their full part.

By and large, then, the nation has reason for satisfaction at the progress made. The first line of defense is 900,000 strong in France and is covering itself with glory. The navy has performed its task well in protecting our ocean transportation lines and in holding the submarines in check. Here at home ships and munitions are coming forward at an ever-accelerating pace, while a nation strong in the purpose of destroying the menace of German militarism, is quickly adjusting itself to the regime of war. Its heart, in a measure, has gone into the conflict faster than its head. Its purpose is better shown by its subscriptions to the Liberty Loans and to the Red Cross, the Y. M. C. A. and the Knights of Columbus funds, than in its actual settling down to a war basis. But where the heart is right, all else will follow. We need not doubt for the future. The big sacrifices, the great sorrows are still to come. We shall bear them in a spirit worthy to be termed American.

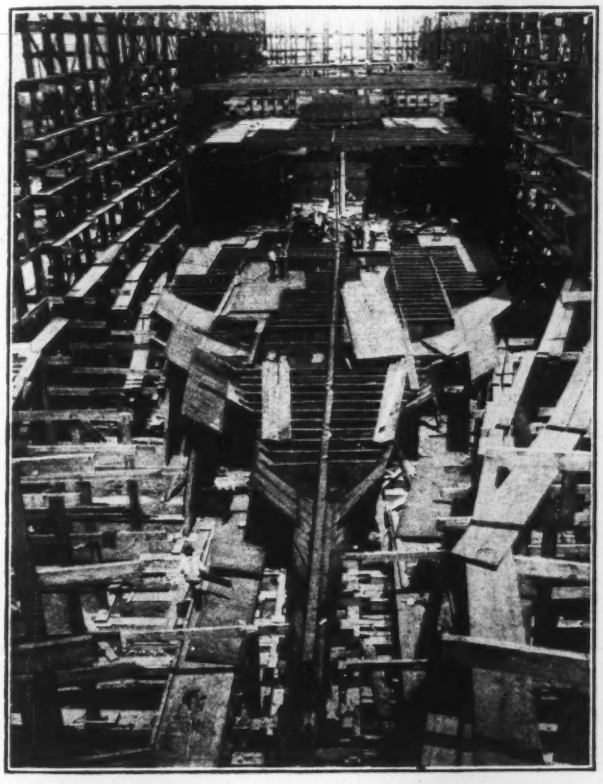
Design Steel Ship for Maximum Efficiency of Bridge-Shop Fabrication

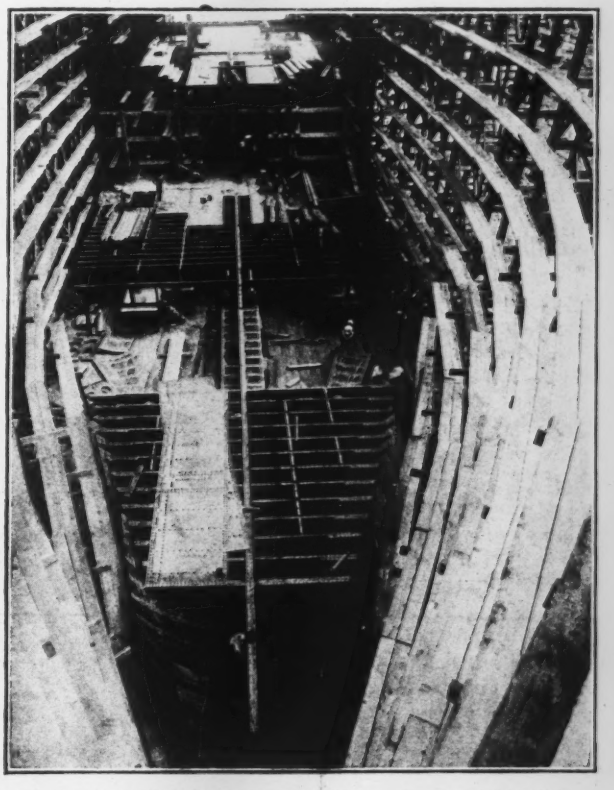
Hog Island a Pure Assembly Plant—Hull Parts Made in Many Distant Shops—Design for Multiple Punching to Develop Greatest Shop Output—Carefully Planned Drawing and Templet Systems

TWENTY-THREE months' time was allowed the American International Shipbuilding Corporation to build at its new Hog Island yard 180 Government cargo steamers, of nearly one and one-half million gross tons carrying capacity. The order meant that 550,000 tons of riveted steelwork had to be produced for assembly into finished ships in a year and a half. Existing bridge shops had to be depended upon to do the work. But no single shop in this country had a capacity nearly equal to the required output, and the half-dozen largest bridge shops, being already engaged in ship work, were not available. The problem was solved by enlisting in the work a large number of small- and medium-sized shops—boiler and tank shops as well as bridge shops—and by working out the design of the ship with such thorough adaptation to existing shop methods as to develop maximum output and greatest economy in fabrication.

It was decided to make the shipyard an assembly plant pure and simple, or, in other words, do 100% of the fabrication in outside shops. This was based on the view that the greatest output capacity would be attained by carrying out to full extent the division of ship construction into shop manufacture and yard assembly. No other large shipyard has attempted to apply the manufacturing principle in this thoroughgoing manner. Two large structural shops are being built at the Hog Island yard, one for correction of error, the other for fabrication in case of default of an outside fabricating shop.

Last August, when the corporation grappled with the emergency shipbuilding problem, it found the situation about as follows: The supply of plates and rolled shapes (though of bridge, not ship, steel) promised to be adequate, and Government priority control was in prospect to regularize the distribution of these materials. Structural or bridge sections of rolled shapes were at the time the only ones available, but a future supply of some ship shapes seemed probable, enough to warrant the use of a limited number in the design. The supply of large steel castings (required for sternposts and rudder frames) was rather in doubt, as other shipbuilding interests had already taken over most of the producing capacity; this suggested the desirability





FIGS. 1 AND 2. CURVED WORK ON HOG ISLAND SHIP (TYPE A) GAVE RISE TO PRINCIPAL COMPLICATIONS ENCOUNTERED IN DESIGN AND SHOP PROCEDURE

of designing the ships to eliminate large steel castings as far as possible. With respect to the shop operations of shearing, punching, bending and forging the hull parts, it was already an obvious fact that existing shops—bridge shops—would have to be depended upon to do most of this work. The market was limited, however, by the fact that the shops of the American Bridge Co. were likely to be occupied largely by ship work for the United States Steel Corporation, and

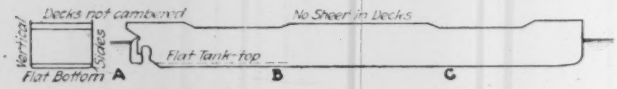


FIG. 3. STRAIGHT LINES OF THE HOG ISLAND SHIP (SECTIONAL AND PROFILE SKETCHES)

that many of the independent shops had already been put under contract by other shipbuilders.

Canvass of the equipment of the available shops showed two facts of primary importance. First, four or five large multiple punches—gang punches with spacing tables—were found, which promised great help in dealing with the plate-punching part of the work; second, there was not enough equipment for bending the frames of the molded parts of the ship or for rolling the curved plates. All other operations required in the fabrication of hull parts could be carried out well and economically by the shops with their regular equipment and methods. This statement applies not only to the punching and riveting, but also to the "stapling" or crimping of angles forming the boundary of water-tight floors and bulkheads and to the welding required at the corner bends of these angles; these operations were sufficiently related to the crimping of plate-girder stiffeners and ordinary bridge-shop forge work so that no trouble was expected.

Some fifty-five bridge shops and boiler and tank shops were placed under contract. To make contracting on a businesslike basis possible at all, bids were called for on the basis of a thoroughly analyzed classification of work. The general design being outlined, it was possible to list and grade the various parts in an arrangement something like this: Water-tight keelson girders; water-tight floors, solid floors, open floors, brackets, shell plating multiple-punched and countersunk, shell plating multiple-punched but not countersunk, shell plating single-punched, sketch plates, beveled liners, furnace plates, stapled angles, etc. Some twenty-two of these classes were listed, and sketches of typical work in each class were prepared for submission to bidders. Prices were

GENERAL DATA ON AMERICAN INTERNATIONAL SHIPS

	Class "A" Ship	Class "B" Ship
Length overall (about)	401 ft.	450 ft.
Length on water-line loaded (about)	390 ft.	435 ft.
Molded beam	54 ft.	58 ft.
Depth to 2nd deck	23 ft.	30½ ft.
Depth to upper deck	32 ft.	40 ft.
Draft loaded (about)	24 ft.	28 ft.
Weight of steel hull (estimated)	3,100 tons	3,400 tons
Weight of wood and outfitting (estimated)	140 tons	300 tons
Weight of machinery with water (estimated)	460 tons	760 tons
Total weight of ship (light)	3,700 tons	4,460 tons
Dead weight capacity (loaded to draft)	7,500 tons	8,000 tons
Total displacement (loaded)	11,200 tons	12,460 tons
Number of holds	5	4
Cubic feet of cargo space	380,000	Not est.
Gross tonnage (estimated)	5,400	6,200
Speed, knots	11½	13
Fuel	Oil	Oil
Oil capacity (about)	1,100 tons	1,600 tons
Oil consumption (24 hours, estimated)	29½ tons	70½ tons
Cruising radius (nautical miles, with one fuel loading)	10,295	8,132
Boilers (number)	3	6
Boilers (total hp.)	870	1,740
Turbines (number)	1	1
Turbines (shaft hp.)	2,500	6,000

asked on the sketches and on certain statements of quantities based on previous information as to the capacities of the various shops.

The bids received formed the basis for letting contracts. In a few instances it developed later that the early type sketches of work were not representative enough and contracts had to be readjusted.

For one or two classes of work, the bids showed that shop facilities were inadequate or absent. The curved plates of the molded ends of the ship are, with a few exceptions, shaped by bending-rolls. Only one bid was received on these rolled plates, and none at all on the bent and beveled frames of the same portions of the ship. The final outcome was that the American International Shipbuilding Corporation equipped several shops with the necessary plant, leaving the price on the work to be adjusted after determination of the actual shop costs.

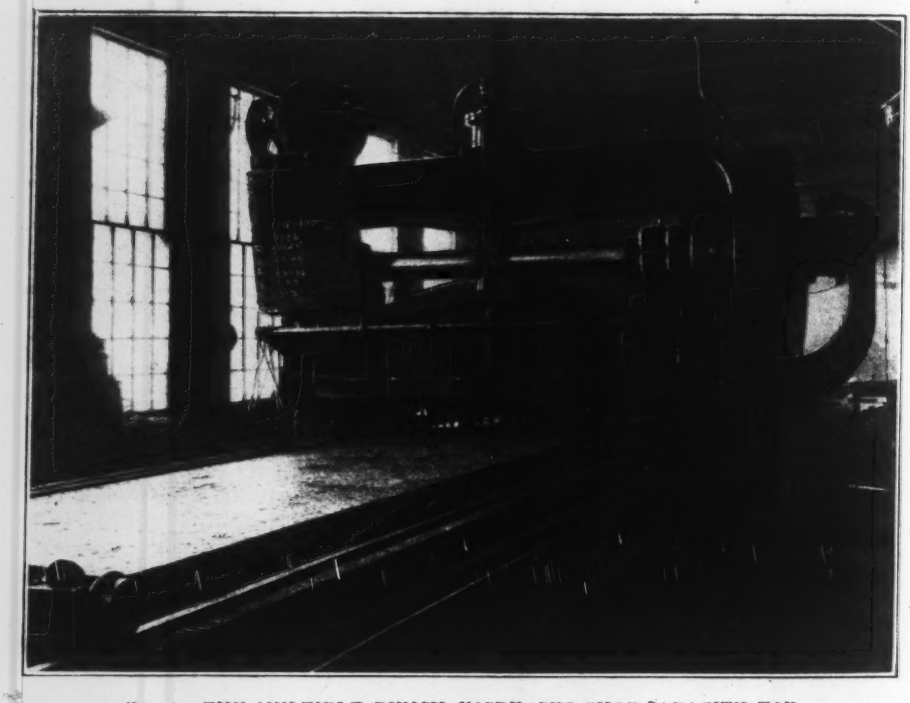


FIG. 4. THE MULTIPLE PUNCH INCREASES SHOP CAPACITY FOR SHIP-PLATE WORK

In planning the distribution of work, concentration of any one class in one or two shops was generally avoided, but certain kinds of fabrication were deliberately concentrated to suit either special experience or special equipment. All the keelson girders are being made at one shop, partly because all the riveting here is "oil-tight" work, which is done most advantageously by a trained organization, and partly because the scarfing of the corners of the web splices of these girders requires a special machine, which this shop provided. All the rolling of curved plates is concentrated in three shops; bending of frames is concentrated in five or six shops and forging of furnace plates in two.

In the case of the rolled plates the concentration makes a certain amount of rehandling necessary. These plates are punched in various shops, and after being punched must be shipped to another plant for rolling before they go to Hog Island. A considerable tonnage is involved, as about 30% of the shell plating is rolled.

In simplifying the general shape of the ship by substituting straight lines and flat surfaces for curved lines or double-curved surfaces, the American International went farther than most of the other emergency shipbuilders, by discarding all sheer, which in conjunction with the elimination of transverse camber made the decks flat from end to end. The sketch, Fig. 3, brings out the main points of modification from normal ship practice as to general shape. The parallel middle body, between points B and C, is straight structural-steel assemblage, except the bilge strake, at A, and the corresponding curved ends of the floors (the transverse girders in the double bottom). Beyond B and C the shell curves inward and the bottom of the ship tapers to bow and stern. Much of the bottom,

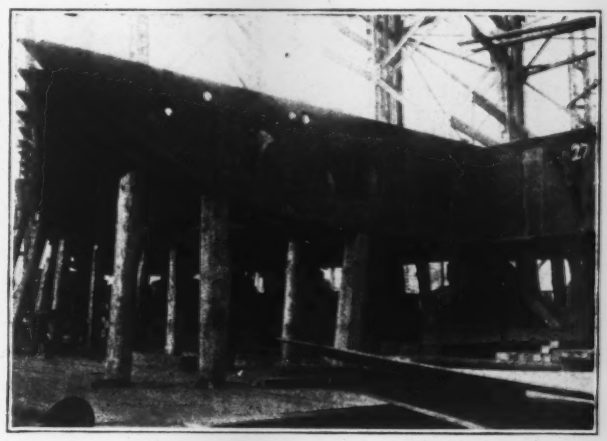


FIG. 6. BENT AND BEVELED ANGLES OF FLOORS IN MOLDED ENDS LINE UP WELL

tank top, decks and bulkheads in these end sections is also straight work, but the frames and shell-plating are molded, and the lower flange angles of the floors are beveled.

The situation as to castings already mentioned led to designing a special form of stern for the smaller of the two ships which the corporation is building, the "A" ship, a 7500-ton vessel. The stern-post casting is here replaced by a structural steel assemblage. Fig. 5 sketches this stern and shows that a large amount of extra bent-plate work is involved, including a number of hot-forged or furnace plates. After designing was completed and fabrication was well advanced the situation of the steel foundries changed so that a dependable supply of large stern-post castings was available, but the ships are being built in accordance with the sketch. The larger ship has a stern of the cruiser type.

Development of the design beyond the point shown in Fig. 3—general outlines of the hull having been given by the Emergency Fleet Corporation—was carried out with an organization trained in bridge and structural steel detailing practice. Painstaking study was given to two objective points: (1) adapting as much of the work as possible to the use of the multiple punch, and (2) carrying out the detailing and representation by drawings exactly as for bridge work, so far as possible. The latter was considered essential as a means of securing most efficient use of the organization and methods of each one of many scattered shops, all trained in current structural-steel fabricating methods.

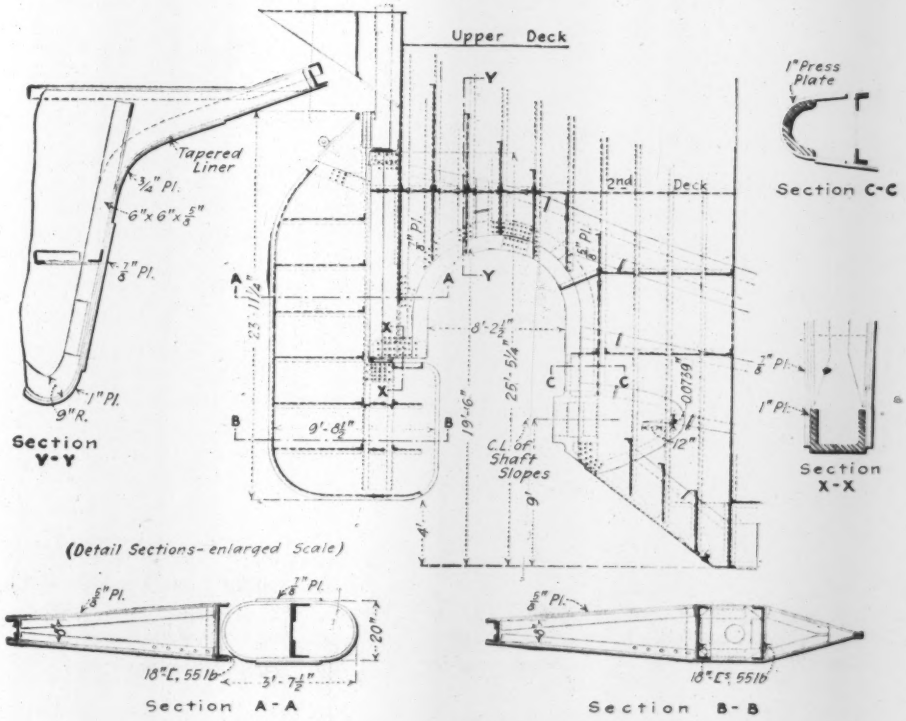


FIG. 5. STRUCTURAL-STEEL STERN OF THE A-TYPE SHIP REQUIRES NO LARGE CASTINGS

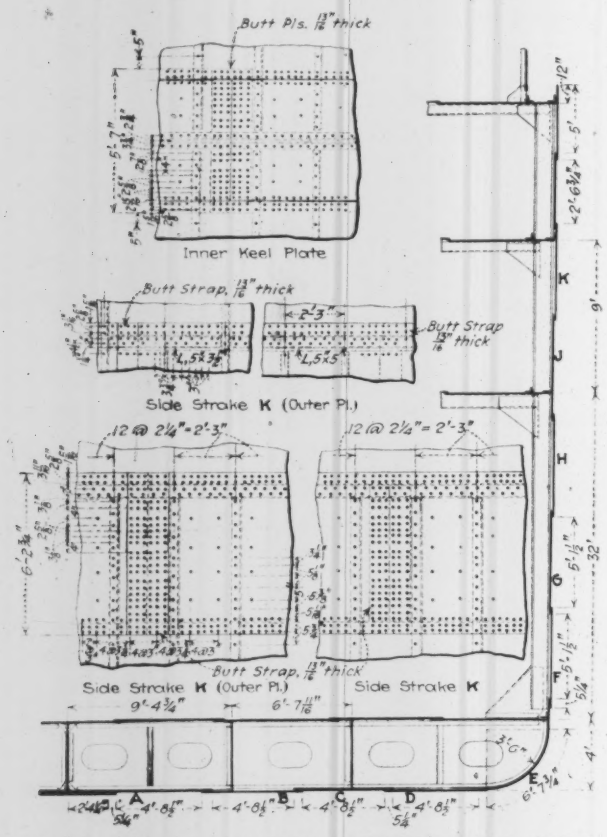


FIG. 7. PORTION OF SHEET SHOWING TYPICAL RIVET ARRANGEMENTS FOR MULTIPLE PUNCHING

Calking introduced no new requirements, as tight calking is fully provided for by using the rivet spacings fixed in ship-classification rules. Packing allowances in the assembly of several thicknesses of steel and allowance for stretch in punching, erection fits, etc., were considered to be no different from those used in bridge and structural practice.

Multiple punching is done at the three or four largest shops which the corporation has under contract. It results in a great increase of output and a marked decrease in cost. The representative of one shop stated that the straight punching capacity of his shop is practically doubled by multiple punches. The prices received in the bidding on the Hog Island work ran more than $5 per ton lower on multiple-punched than on single-punched work—a saving which will affect nearly 100,000 tons of steel before the corporation's present orders are filled.

Current rivet-spacing rules of ship classification societies such as the American Bureau of Shipping make multiple punching impossible, the designers found. Any shell plate, for example, has at least four different transverse rivet rows—at ordinary frames, at watertight floors or bulkheads, at the butts (splices with the adjoining plates of the same strake), and between frames, where only the marginal or seam riveting occurs. For each of these locations the classification rules prescribed rigidly defined rivet spacing, as, 6 rivet, diameters at frames, 5 diameters at oil-tight bulkheads, 4 diameters at quadruple-riveted butts, etc. With these spacings it was not possible to line up the holes to suit the machine, as the gang punches cannot be set closer than about 2 in. and it is therefore necessary that, when all rivet rows are assembled into one, no spacing closer than 2 in. should occur.

The structural engineers of the American International Shipbuilding Corporation, strongly convinced of the value of multiple punching, took up the matter with Lloyds' surveyors. The final outcome was that certain departures from the rivet-spacing rules were agreed upon, which permitted the plate work to be detailed for multiple punching. In substance, it was agreed that the rivet spacing might be varied from that prescribed by the classification rules to the extent of one-half rivet diameter, continuing for three or four rivet spaces before equalizing. The effect of this was that, by shifting the butt or the frame spacing a slight amount for successive short lengths of the rivet line, the two could be made to match for 2-in. minimum spacing. Specimens of typical shell-plate punching are shown in Fig. 7, which reproduces part of the designing sheet showing typical arrangements of punching for multiple work.

The entire problem was worked out on this basis with complete success. Besides the general drawings of standard multiple punchings just referred to, each single plate was shown in full detail on a sheet of its own, for the shop. Assembly drawings of large sections of multiple-punched plates and erection diagrams were also laid out. These and the sheet of standard punchings helped in the templet shop as well as in the

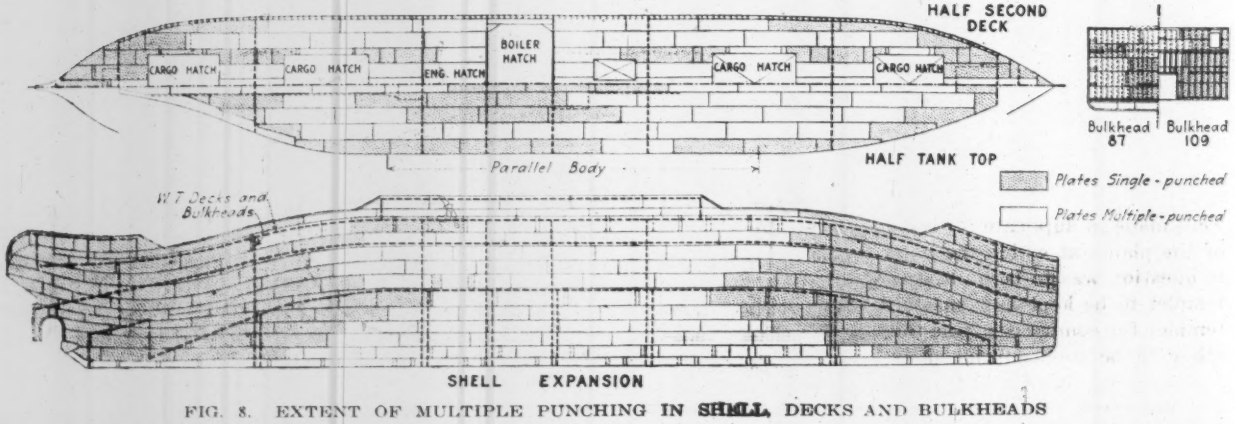


FIG. 8. EXTENT OF MULTIPLE PUNCHING IN SHELL, DECKS AND BULKHEADS

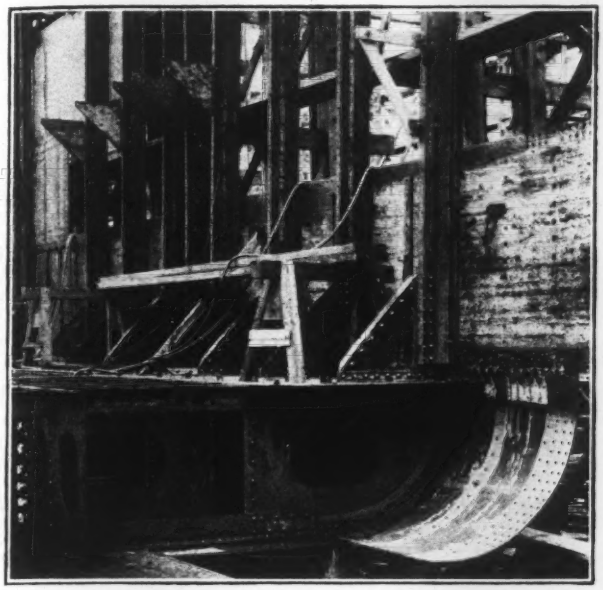


FIG. 9. PARALLEL-BODY CONSTRUCTION IS CLOSELY SIMILAR TO NORMAL STRUCTURAL WORK

drafting room, facilitating the layout and giving a check on the detail drawings.

Multiple punching was extended in all cases as far as possible. All the straight plates of the shell are multiple-punched, as are all bulkhead plates up to the irregular edge section (Fig. 8). The same is true of all decks and the tank top plating. In the case of the webs of the solid floors, all holes except those in the curved ends were lined up for the multiple-punch spacing, leaving the others to be done in a single-punch operation. In a few plates, where both ¾-in. and 1-in. holes are required, all holes are punched ⅞ and when needed are reamed to 1-in. size.

The templet system adopted by the American International is as follows: All molded work was laid out full size in the Camden mold loft of the New York Shipbuilding Corporation—a company affiliated with the American International Shipbuilding Corporation—following regular shipyard practice. All complete working templets were made in duplicate for each of the plants at which the part in question was to be built, one templet to be kept as a master templet for comparison, and the other to be used in the shop. No templets were made for the straight parts, but these were left for the several fabricating shops to take care of in their customary manner on bridge and building work.

The corporation's templets are all of wood—cardboard templets were rejected at the start—and shipping these to the fabricating shop involved such expense and risk of damage that it was urgently desirable to limit the number of Camden templets to the minimum. Since all structural shops regularly make templets for the work ordered of them, no advantage to the straight part of the ship work could be realized by making templets at Camden and shipping them to the shop, provided full and accurate drawings were furnished. On the contrary, it was believed to be a distinct advantage to vary the whole procedure as little as possible from that customary in bridge and building work. In the case of a bulkhead, the central rectangle was detailed on drawings. The sketch-plate portion along the two edges, however, was laid out in the mold loft, and templets were made and shipped to the shop.

The effort throughout was to suit existing shop methods, in order that all parts of each shop organization would get into the work without hitch or loss of speed. This consideration dictated not only leaving the templet making to the fabricating shop, but also working out the drawings as closely as possible in accordance with ordinary structural practice.

Under this system, which called for shop drawings in very much larger number and also of greater com-

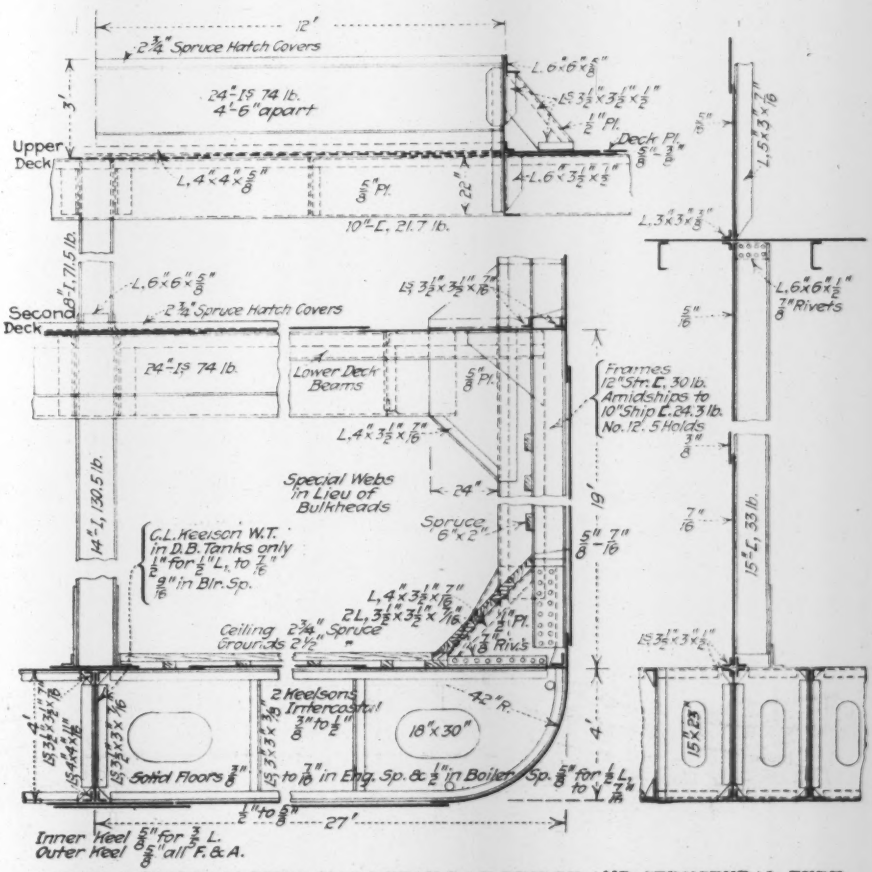


FIG. 10. MIDSHIP SECTION HAS DETAILS OF BRIDGE AND STRUCTURAL TYPE

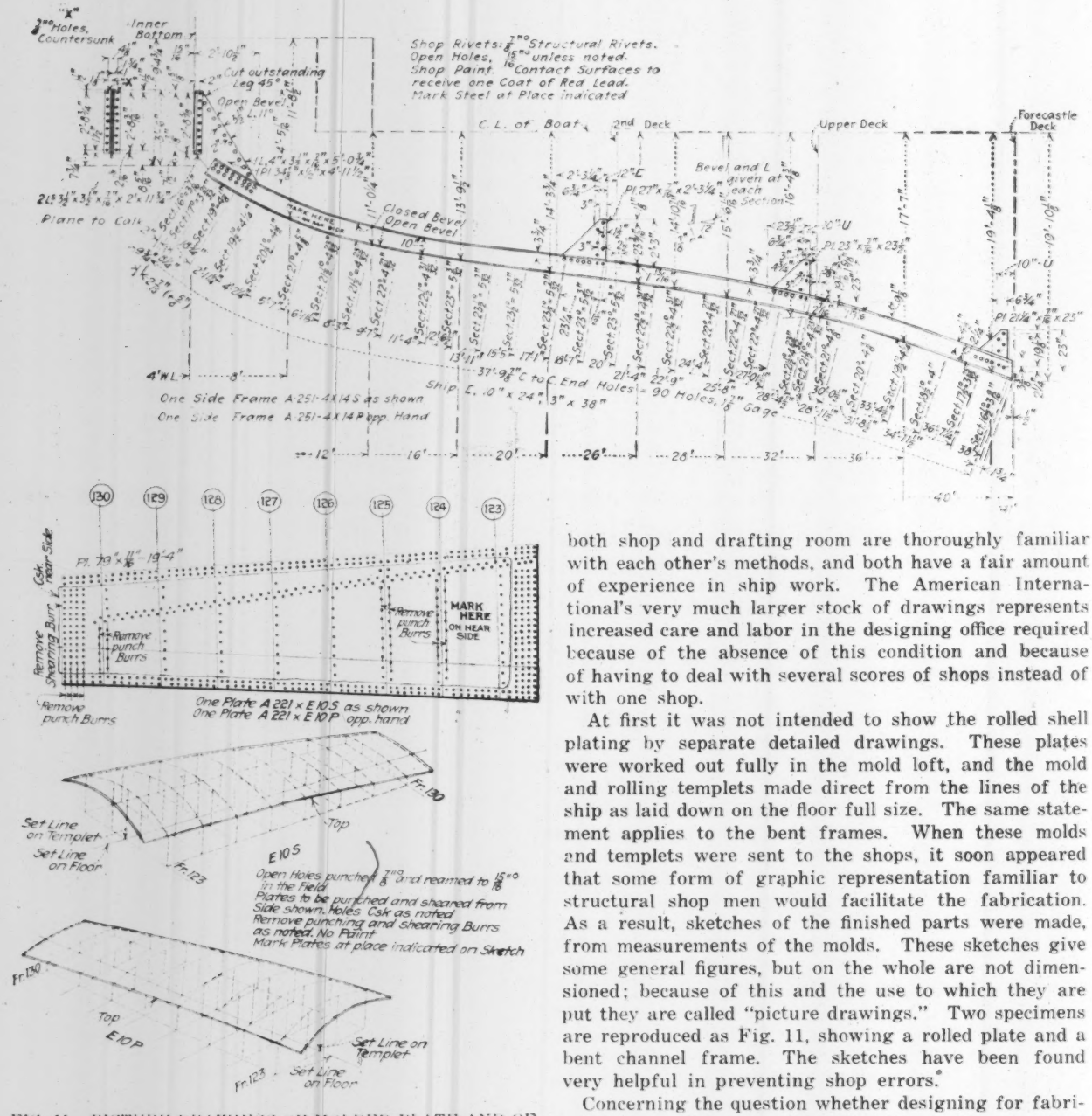

Shop Rivets: 7/8" Structural Rivets.
Open Holes, 15/16" unless noted.
Shop Paint. Contact Surfaces to receive one Coat of Red Lead.
Mark Steel at Place indicated
C. L. of Boat
2nd Deck
Upper Deck
Forecastle Deck
Bevel and L given at each Section
Closed Bevel
Open Bevel
Cut outstanding Leg 45°
Open Bevel
Plane to Coll
4'W.L.
One Side Frame A 251-4X14S as shown
One Side Frame A 251-4X14P opp. Hand
Ship L. 10" x 24" 3" x 38"
90 Holes, 7/8" Gage
MARK HERE ON NEAR SIDE
Remove punch Burrs
Remove Shearing Burrs
One Plate A 221 x E10S as shown
One Plate A 221 x E10P opp. hand
Set Line on Templet
Set Line on Floor
Fr. 130
Fr. 123
Top
E10S
Open Holes punched 7/8" and reamed to 15/16" in the Field
Plates to be punched and sheared from Side shown. Holes Csk as noted
Remove punching and shearing Burrs as noted. No Paint
Mark Plates at place indicated on Sketch
E10P

FIG. 11. PICTURE DRAWINGS OF MOLDED PLATE AND OF BENT CHANNEL FRAME

pleteness than ordinary ship practice requires, thorough detailing and the preparation of a full set of working drawings early became established practice in the American International's hull-designing division. The distance between shops and drafting room increased the desirability of thorough detailing, as the clearest possible form of representation would be most likely to avoid delays and misunderstandings in the shop.

In this way a very comprehensive set of drawings was built up. The 7500-ton ship (the "A" ship) requires some 1300 sheets. A ship of somewhat larger size, being built by another company, is completely covered by about one-tenth as many; but in this case, both shop and drafting room are thoroughly familiar with each other's methods, and both have a fair amount of experience in ship work. The American International's very much larger stock of drawings represents increased care and labor in the designing office required because of the absence of this condition and because of having to deal with several scores of shops instead of with one shop.

At first it was not intended to show the rolled shell plating by separate detailed drawings. These plates were worked out fully in the mold loft, and the mold and rolling templets made direct from the lines of the ship as laid down on the floor full size. The same statement applies to the bent frames. When these molds and templets were sent to the shops, it soon appeared that some form of graphic representation familiar to structural shop men would facilitate the fabrication. As a result, sketches of the finished parts were made, from measurements of the molds. These sketches give some general figures, but on the whole are not dimensioned; because of this and the use to which they are put they are called "picture drawings." Two specimens are reproduced as Fig. 11, showing a rolled plate and a bent channel frame. The sketches have been found very helpful in preventing shop errors.

Concerning the question whether designing for fabrication, as in the case of the Hog Island ships, involved a considerable increase in the number of rivets to be driven, H. G. Balcom, the corporation's consulting engineer, states that substantially no more rivets were required than would be used under conventional ship-design methods. The variations of spacing for the multiple punch were so applied as to hold down the number of rivets to that necessitated by Lloyds' rules. At only one or two connections are excess rivets used, for convenience in matching spacing; the total number is 2000 or 3000 per ship—about one-half of one per cent.

Of the 586,000 rivets in the "A" ship, only about 20% are shop rivets, while 466,000 must be driven on the ways.

The variable countersinks ordinarily used in ship

FIG. 12. COUNTERSINKING RIVETS AND CALKING SEAMS FORMS LARGE PART OF SHIP CONSTRUCTION

work were modified to the standard shown in Fig. 13; a single taper is used for a given rivet size. The American International ship has in general only $\frac{7}{8}$- and $\frac{3}{4}$-in. rivets; $\frac{7}{8}$-in. rivets are used everywhere in the shell plating, except at the sheer strake, where 1-in. rivets were insisted upon according to the rules, though an equivalent joint with $\frac{7}{8}$-in. rivets was designed. Straight (cylindrical) rivets are used in nonwater-tight work, and swell-necked rivets in members required to be water-tight or oil-tight.

Punches for rivet-holes in all work made to detail drawings are $\frac{1}{16}$-in. larger than the nominal size of the rivet, and the dies are $\frac{1}{8}$-in. larger. This reduces reaming to a minimum. Some of the early work was punched $\frac{1}{16}$-in. smaller than this, to give sufficient metal for reaming in bringing holes to match, but the allowance was soon found to be unnecessary. Holes in molded work are made with punches of diameter equal to the rivet size.

The drawings specified all points where the burr produced in punching was to be removed. In general, this was at all holes where the die side of the hole came on the contact surfaces of plates. In the regular shell plating, holes are punched away from the contact surface, and the burr, coming on the outside, is removed by the countersinking. Where three thicknesses of metal occur, however, it was required that the punching burr on the middle thickness be removed.

Burrs at sheared edges also had to be removed at those contact surfaces where calking was necessary. Where the burr came at the outside of such an edge, the slight rounding at the point of calking, caused by the pressure of the shear blade, did not interfere with satisfactory calking. It was not required to plane or chip such edges in the shop, and very little chipping was found necessary on the ways.

The edges and ends of shell plates are not planed except where plates butt, as at the inner edge of the strake adjoining the flat keel, the ends of the flat keel, etc. The total amount of this work in the "A" ship is about 4300 lin.-ft. of edge.

Scarfing of plates at the junction of seams and butts of the plating, customary in ship work, requires special equipment, which the bridge shops lack. To provide special rigs for the work would have meant much trouble and delay, it was feared, and on this account scarfing was rejected at the very start. Instead, taper fillers are used, so-called "beveled liners." The amount of extra weight which they add is said to be small, but they have proved troublesome in erection, as the rivet holes through the liners must be drilled in the field because of the variations in the width and edge distance of plates. The exposed edges of liner and abutting plate are required to be calked water-tight, and for good calking the heel of the liner must fit close to the abutting edges of the plate, and the side of the liner must project slightly beyond the edge of the outer plate; it is likely that these required conditions will not be realized if the holes in the liner are punched in advance.

At one point of the ship scarfing is used—in the web splices of the keelson girder. Following ship practice these splices are lapped instead of being butted and fitted with covers as in ordinary plate girders; the lap splice has shorter rivets, which favors the tight calking required to make these girders oil-tight. The lapped plates are scarfed at their upper and lower edges, where they are seated between the flange angles of the keelson girders, so that these angles do not need to be joggled (crimped). All the keelson girders were allotted to a single shop, which has equipped a scarfing machine for the web plates and finds no difficulty in the work.

In normal ship practice, bracket plates such as those connecting frames to tank top and deck beams are com-

FIG. 13. COUNTERSINK STANDARDS OF AMERICAN INTERNATIONAL SHIPBUILDING CORPORATION

monly flanged over on their free edges, to stiffen them. The operation of flanging is not readily done in bridge shops, however, no equipment for it being provided because structural-steel practice does not employ flanging. In detailing the ship, therefore, stiffener angles were called for at these points, and flanging of details was everywhere avoided.

The number of double curved or forged plates in the shell is increased by the special stern shown by the drawing, Fig. 5, as several complex forged parts are required for this stern. Elsewhere only about a dozen forged plates occur in the shell. One or two shops specially equipped for die forging do all of this work, molds for the dies being furnished by Hog Island.

Intercostals, or longitudinal members fitted between floors, were detailed $\frac{1}{16}$-in. shorter than the theoretical length. They were required to be assembled and riveted up in metal frames to this dimension. This allowance proved wholly satisfactory in the erection; no trouble from slack or cramping was reported from the ways.

In fitting parallel liners under the outer plates of the shell and tank top at water-tight floors, a close fit had to be secured so that tight calking would be feasible. These liners were ordered $\frac{3}{4}$-in. over length,

and on the ways their ends were chipped to fit tight between the edges of the inner strakes.

A class of work unusual for bridge shops is found in various holes and notches required at many points. These include a large number of access holes in the floors and longitudinals, notches in the longitudinals to pass the chords of the open floors, and notches in stringer plates of the second deck to pass the frames. In some shops the holes and notches have been cut by special punches. In the majority of shops, however, this work is being done with oxyacetylene flame. The corporation left the method of doing the work optional with the shops; no special requirements were made as to finish.

Standardization or systematization of design is not confined to the hull work, but appears just as prominently in the equipment—piping, machinery, etc. A striking item of standardization is illustrated by the detail construction of the propeller shaft. This shaft is made with its five intermediate sections interchangeable, as much to simplify storage and erection as for shop economy. Every point of the equipment to which such simplification could be applied was treated correspondingly.

Training Engineer Officers for the Army at Camp Lee

Experienced Engineers, Now Reserve Officers, Enlisted Men and College Boys Work Side by Side to Fit Themselves for Service Overseas

By Frank C. Wight
Associate Editor, Engineering News-Record

FORTY young and vigorous soldiers seated around a lone tree; in the background the familiar multiplied roofs of a cantonment; in their direct gaze a triple Burton tackle hanging from a limb, and alongside, the standing figure of a well-remembered professor of engineering now wearing the double bars on his shoulders and the castle on his service shirt collar. Five different opinions from as many men as to the pull on the captain's hands from the line weaving its way through snatch block and pulley to a supposititious hundred pounds in a dependent bucket.

A line of crouching men, shell pits, wire barriers, trenches and at the end a hundred dummies waiting for the thrust of a hundred bayonets, a command, a chorus of deep and threatening growls, and a plunging company goes by in a mimic "over the top." As they come up one recognizes in a grayhaired, lithe, but tired-looking soldier the city engineer of a large and busy city, on the books as a major, Engineer Officers' Reserve, but here in camp no better or no worse than the boy at the nearby tree who is not quite sure how big a proportion of a load passes through the single-turn pulley.

CANDIDATES FOR ENGINEER COMMISSIONS GO THROUGH THE DAILY ROUTINE OF THE SOLDIER

The two pictures visualize the two main problems in the early weeks of the engineer officers' training camp. Each is a part of a necessary course of instruction; each is a step in a process of elimination. Every day a few of the candidates show themselves hopelessly incompetent in the engineering groundwork an engineer officer must have; every week some quite competent engineer fails physically or mentally to measure up to the military requirements of a soldier. The instructors must put the whole ill-assorted mass through the same routine to sift out the different types of incompetence, or in some cases, of incompatibility.

Fourth Camp Now Under Way

Three engineer officers' training camps have been held since the war began. From them have gone forth nearly 6000 officers now en route to France or in service overseas. The fourth camp under way at Camp Lee, near Petersburg, Va., has profited by the experience of its predecessors; its course of instruction is a development of a year; in its corps of instructors are many officers who have served in two or even in three of the earlier camps. Except for the personnel of the students, happily to be improved by the recent call for more engineer officers, it is typical of the coming camps into which more and more of the engineers of America must go. The grade of student is lower, because regimental commanders have defeated the purpose of the General Staff to promote worthy privates and noncommissioned officers by sending to the camp a number of men who by no intensive training could ever become officers, much less engineer officers, but whose removal might conceivably raise the standard of the regiments from which they came.

The Camp Lee training camp now has about 1400 men, a third of whom are reserve officers and two-thirds enlisted or drafted men detailed there for instruction. Among the latter are a number of members of the so-called Engineer Enlisted Reserve, seniors of engineering colleges whose standings during their four-year course have been at least as high as that of the upper third of the students for the previous ten years. All of the men, regardless of their source or their rank, are for the time being considered as privates in companies whose officers are the camp instructors. There are six of these companies, each quartered in the regulation barracks of a divisional cantonment, a portion of which has been assigned to the training camp as a unit independent, except for general regulations, from the remainder of the cantonment.

Officers at the Camp

In command of the training camp is Lieut. Col. V. L. Peterson, Corps of Engineers, U. S. A., and under him as senior instructors are six majors of the Corps of Engineers; R. U. Nicholas, D. O. Elliott, Harrison Brand, Jr., G. J. Richards, A. P. Cronkite and D. A. Harrison. In command of the six companies at the camp are the following reserve engineer officers: Capt. E. B. Wilhelm, Capt. C. T. Chenery, Capt. H. H. Allen, Maj. W. A. Ritchie, Maj. George Blow and Maj. H. F. Cameron, each of whom has on his staff seven other reserve officers acting as assistant instructors. Attached also to the camp are commissioned and noncommissioned officers of the allied armies, men who have seen service in France and whose instruction, therefore, will have the emphasis of experience as well as a special appeal to the student. Some of the assistant instructors, too, have just returned from service at the front, so as to bring the instruction in close touch with the changing conditions of modern warfare. More are expected in the future.

As far as discipline is concerned, conditions of the regular army cantonments prevail. It is continually kept in mind that soldiers are being trained—engineers, of course, but men who will have to enforce discipline and command troops in the field. The famous incidents of the Cambrai fight and of General Carey's "scrap" army, which stopped the advance near St. Quentin, are well known examples of the fighting engineers. Many other incidents, small in themselves though of great importance to the unit concerned and of strategical importance to the whole Army, have been filtering back from the front. Engineers, even pioneer engineers, are not expected to have to do much fighting, but they have to be ready to fight if the need arises.

Hours of Work at the Camp

The camp, therefore, follows in its schedules and rules the familiar cantonment training camp system. Reveille is at 5:45, breakfast at 6:20, and the men are at work at 7 a.m. An hour from 12 to 1 is allowed for dinner, and from 1 to 4:30 instruction continues. After dinner there is an evening study period from 6:30 to 8:30, and taps are sounded at 9:30 p.m. Little time is left for anything but intensive work.

The object of the camp is to impart a sufficiency of military information and sense of military discipline, so that the students as officers can command troops, and at the same time to lay the rudiments, at least, of military engineering on the foundation of civilian engineering which the candidate must have in order to become a successful engineer officer. The first four weeks of the 12 to 14 weeks in camp are given over largely to military instruction and training in the manual of arms, in musketry, physical drill, bayonet and target practice and in tactics, signaling and general maneuvers. This is in charge of the company officers, with advice and supervision by the senior instructors, all of whom are West Pointers. It includes also conferences and lectures on the treatment of animals, wagon, harness and stable management, and on general tactics, together with thorough instruction in administrative work. While all this military instruction is not as elaborate as the similar instruction given to the draft armies in the cantonments, it is more intensive. Judging from the military appearance of men who have been through only four weeks of its routine, it is quite effective in producing a soldierly bearing and an appreciation of military fundamentals. It certainly requires physical qualities not infrequently lacking in the older desk man but which the field engineer has in full.

About the fifth week of the camp engineering instruction begins to predominate. The mornings are devoted partly to military instruction, but some of the companies each morning are engaged in engineering work, and all of the companies give every afternoon to technical details. The engineering instruction is designed for the development of pioneer engineers; that is, the men who

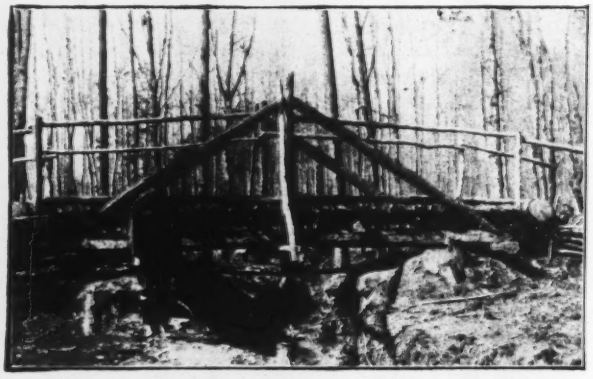
MAJOR DAVISON AND LT. COL. PETERSON (ON HORSEBACK)

LIEUT. SATTERTHWAIT, CAPT. SCHODER, MAJ. CAMERON AND MAJOR RICHARDS

STUDENTS RECEIVING INSTRUCTION ON TACKLES

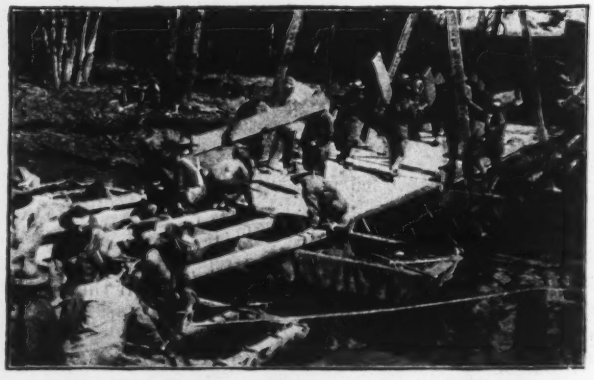
QUEEN POST TRUSS BUILT IN FIELD

SINGLE LOCK SPAR BRIDGE LOADED



KING POST TRUSS BRIDGE BUILT IN FIELD

PILE DRIVING BY HAND



LIGHT PONTOONS ACROSS THE APPOMATTOX

serve with the active army. The student Bible is the engineers' field manual, issued by the War Department some years ago and revised since the present war started. With that as a basis, the engineer instructors try to hammer fundamentals into the students in six to eight weeks.

Varying times are devoted to each subject, but as a rule a company spends an entire afternoon in one line of work. Regular college schedules are maintained, showing the assignments from day to day, so that any afternoon each of the six companies will be engaged in a different line of study. Senior instructors specialize in special branches and take the companies as they come to the study of each of these branches. Company instructors remain with their companies through their entire program.

Military Engineering Studies

The subjects of study are familiar. They include reconnoissance, field fortifications, trench warfare, wire entanglements, bridges, demolition, pontoons, revetments, rigging, mining and roads. So far as possible, actual service conditions are approximated. The camp has a full set of three lines of trench defense, with the usual accompaniment of boyaus, dugouts, tunnels, listening posts, shelters, bomb proofs, machine gun and Stokes mortar emplacements, etc. Study of this trench system is made and at the same time the students themselves put in short tricks at digging special types of trenches, dugouts and shelters, under the expert direction of those foreign instructors who have seen actual service.

The adjoining river, the historic Appomattox, and many gullies and depressions afford fine opportunity for bridge and pontoon practice. Each group of students must devote a considerable amount of time in setting up pontoon bridges and in building trestle bridges, cutting the wood for the latter from the trees covering a large part of the outlying sections of the camp. Map-making, too, is a subject in which actual service conditions can be approximated, and all day long in the early weeks of the camp squads of soldiers can be seen in the woods and roads equipped with the light army plane table.

System of Marking

Through all of this process the engineer instructors are keeping constant and vigilant observance of the candidates. A system of weekly marking is maintained according to rules laid down by the Adjutant General's office for the selection of officers at all training camps. Together with these weekly markings, which are given by all the instructing officers and are weighted according to the rank of the officer to make up the final average, there are frequently written examinations and the standard psychological examination, "which measures intellectual and not educational status" and which all candidates for army commissions must undergo. Obvious misfits are soon returned to private life, or, if already in the service, to their commands, but those who survive the early weeding out as a rule remain until the end of the camp, when the case of each man goes before a final camp board made up of the senior officers. Its recommendations as to the disposition of the candidates are in practically every case adopted. The college and enlisted men are rarely commissioned above second lieutenant. The reserve officers are either honorably discharged or are "graduated" from the camp and assume their rank in whatever assignment is given them.

Pragmatically, the engineer officers' training system is good. It works. The men who have been turned out in the past are making successful engineer officers in France today. The men who are at camp now, from "doughboy" to lieutenant colonel—and one may see them side by side in their blue dungarees—are in deadly earnest. And no less in earnest is the fine group of instructors, each one of whom is giving up his dearest wish—to see service at the front—in order to train the men who must do the pioneer work in the new armies now going over. Lieutenant Colonel Peterson, the commanding officer, is a field engineer of long experience in the Philippines and on the Rio Grande. He appreciates the needs of pioneer engineering as well as he does those of military instruction, and it is his constant effort to impress on his corps of instructors the equal importance of the two. His tall, lean figure and bay horse as he rides from squad to squad on various work are as familiar to the students as are their own immediate officers. To him is in no small measure due the "pep" which characterizes the men as a whole.

Call for More Engineer Officers

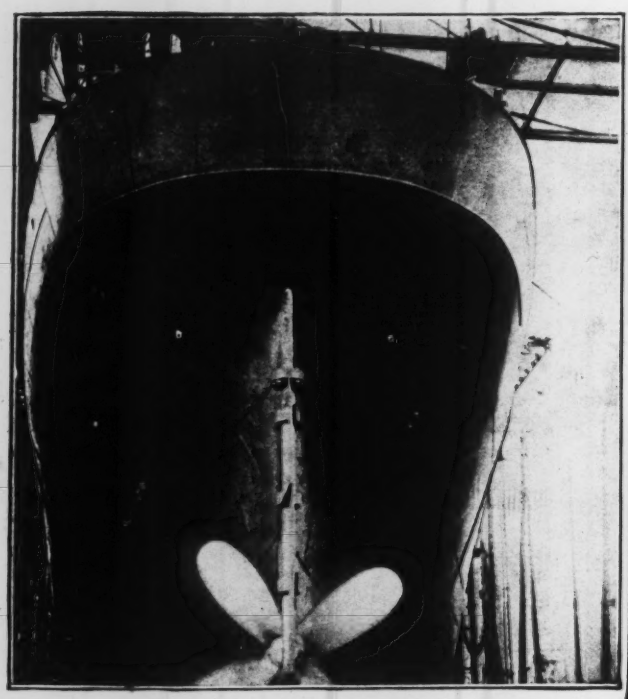
An increased army and the poor quality of the enlisted men designated for training in the last camp have led to a call for more engineer officers from civilian life. Two thousand or more of these men no longer in the flexibility of the twenties will have to go through the strenuous discipline of the training camp this summer, but, judging from the past, what these men lack in suppleness of body they will make up in eagerness of intent and readiness of mind. The training of the engineer officers now is for actual service with pioneer troops in war, and the news dispatches every day emphasize how much more real is the promise of actual service than it was to the students in the earlier camps. This imminence of real war should make the coming camp, which will probably be moved to Camp A. A. Humphreys on the Potomac, if anything more serious and workmanlike than those that have gone before.

Red Cross Uses 634 Motor Cars in France

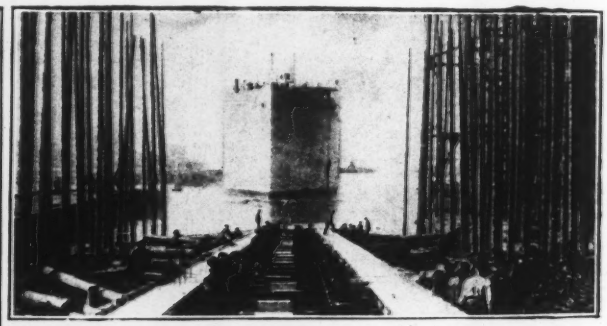
The motor transportation system of the American Red Cross in France handles, on the average, 2500 tons of freight monthly at the 14 ports of entrance, moves nearly a thousand tons per week from Paris stations and the Seine landings, and transports supplies, workers, refugees and wounded in all sections of France. Of the fleet of 634 vehicles, 385 are trucks and ambulances, 246 ordinary cars and 22 motorcycles. The Red Cross maintains two large garages and an automobile park in Paris. Fifteen other garages meet the needs of the port and other transportation services. Complete machine shops, with skilled mechanics, are maintained at the chief garage, and quick repair maintains speed in handling goods. Over 80% of the Red Cross supplies have to pass through Paris on their final journey of relief. Practically every article shipped via the Red Cross from America is handled by this system.

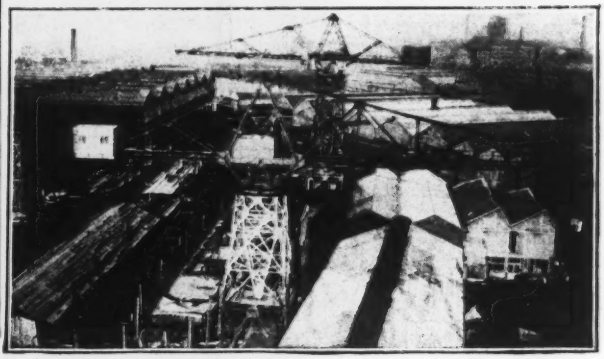
British, Too, Are Building "Standard" Steel Ships

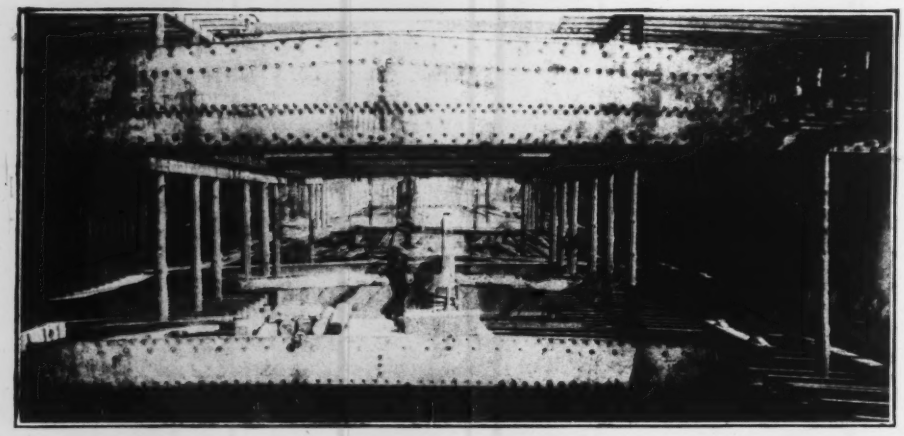
Photographs © British Pictorial Service.



SIMPLIFICATION SHOWN IN STERN







ABOVE — HAMMERHEAD CRANES COMMON IN BRITISH YARDS

BELOW—PREPARING WAYS FOR NEXT SHIP AS ONE IS LAUNCHED

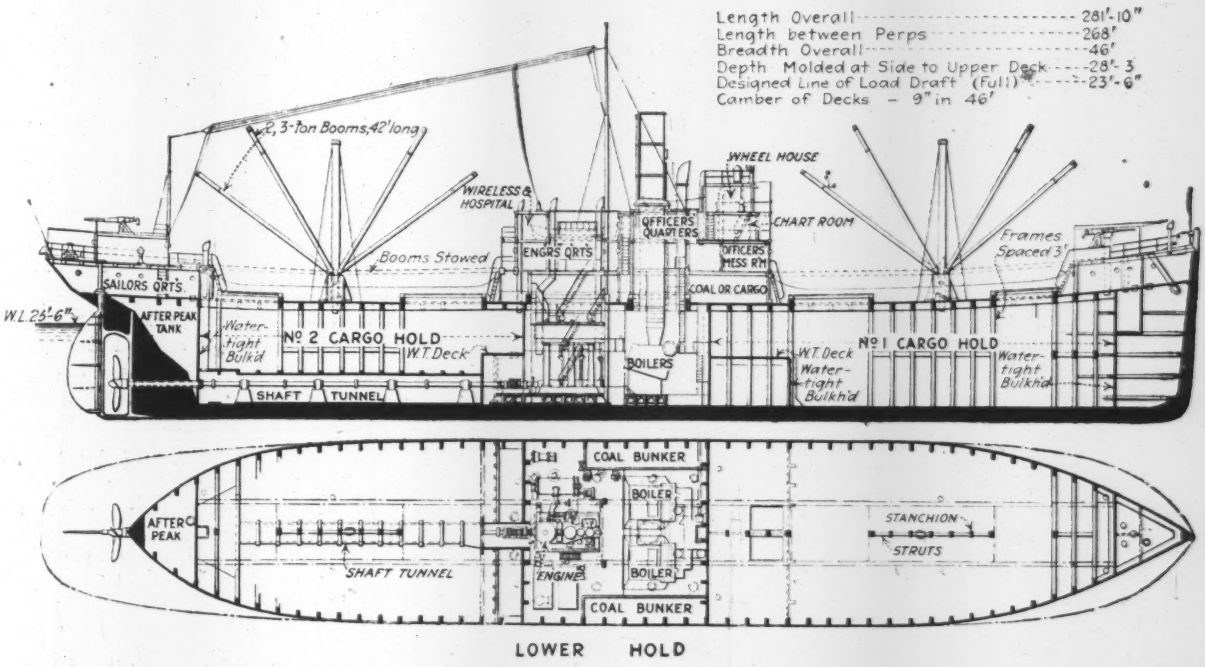
LEFT—CURVED WORK STILL CONSPICUOUS, A SAVING FROM STANDARDIZATION BEING EVIDENTLY CHIEF GAIN OVER OLD SHIPYARD PRACTICE

ERECTION FALSEWORK AND TEMPORARY POSTING BETWEEN DECKS ON A "STANDARD" SHIP

Government Designs and Builds 3500-Ton Concrete Ships

Shape and Size of Vessels Under Construction Follow Standard Wooden Ship of Same Tonnage—Usual Concrete Details Adapted to Seagoing Ships

CONCRETE ship construction is now being undertaken by the United States Government on a large scale. Vessels of approximately 3000-ton, 3500-ton and 7500-ton cargo carrying capacity have already been contracted for, and construction on the smallest of the three types, designed by the contractors under Government supervision, has been commenced in two yards. The concrete ship department of the United States Shipping Board, Emergency Fleet Corporation, of which R. J. Wig is chief engineer, has also prepared the design for the 3500-ton ship, of which two are to be built. For the first time in any publication the details of this ship are presented here.



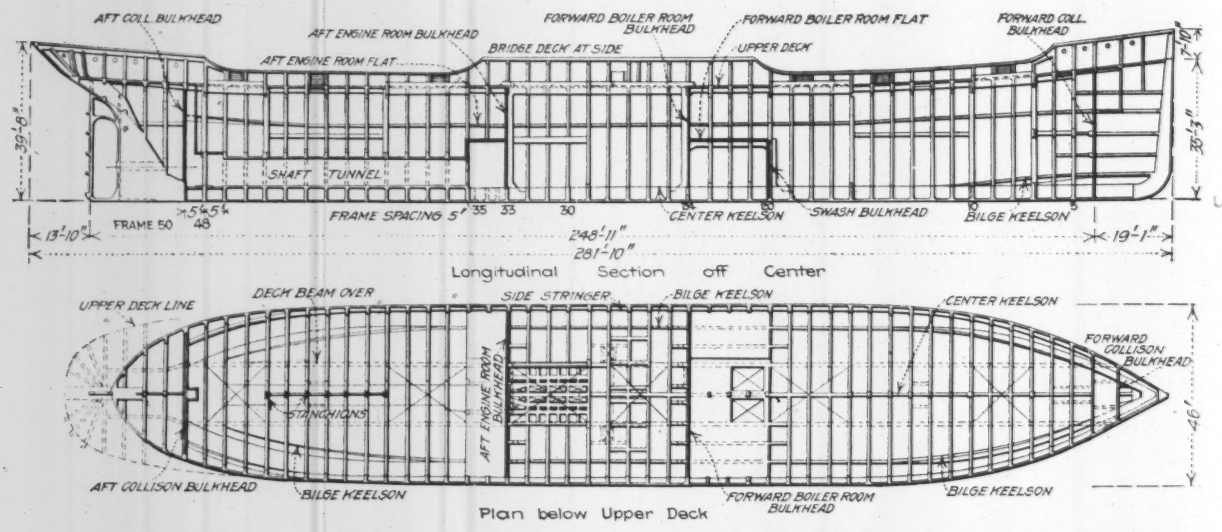
IN GENERAL LAYOUT THE GOVERNMENT'S NEW 3500-TON CONCRETE SHIP IS SIMILAR TO THE STANDARD WOODEN SHIP BEING BUILT BY THE EMERGENCY FLEET CORPORATION

To utilize the already designed and partly manufactured engines and fittings for the Fleet Corporation's standard wooden ships, the first standard concrete ship was made of approximately the same capacity, dimensions and form, except that the sheer line amidships of the concrete ship has been slightly altered and no exterior keel is fitted. The general arrangement of the ship itself and of the propelling machinery is the same in both types. As shown in one of the drawings, the ship is of single deck over its full section, with a poop deck at the stern, a forecastle deck at the bow, and a bridge deck, with a wood frame cabin house, amidships. A single screw turned by a 1400-hp. reciprocating engine located amidships will give a speed of approximately 10½ knots. The boilers may burn either coal or oil.

The ship has a length over all of 281 ft. 10 in., a length between perpendiculars of 268 ft., beam over shell of 46 ft., depth amidships at sides of 28 ft. 3 in., and a loaded draft of 23½ ft. As shown in Table I, giving the comparative weights of concrete, wood and steel vessels of the same type, the concrete ship light weighs 2972 tons, has a carrying capacity of 3203 tons, and a full-load displacement of 6175 tons. It compares closely in these dimensions with the similar wooden ship of somewhat larger dead-weight carrying capacity, but, as will be noted from the table, it is nearly twice as heavy empty as a steel ship, similarly rated, which has a carrying capacity 10% greater. Estimates of cost by the Shipping Board are between $100 and $125 per ton for concrete ship dead-weight carrying capacity as against $165 for wooden ships and $180 to $220 for steel ships.

TABLE I. COMPARATIVE WEIGHTS OF CONCRETE, WOOD AND STEEL VESSELS OF NOMINAL 3500-TON DEAD WEIGHT CAPACITY

	Concrete	Wood	Steel
Hull	2,500	2,300	1,160
Fittings, outfit, and equipment	191	191	180
Propelling machinery	206	206	200
Margin	75	80	60
Ship (light)	2,972	2,777	1,600
Reserve feed	80	80	80
Ordnance	23	23	23
Fuel	300	300	300
Stores	40	40	40
Cargo	2,760	2,180	3,057
Total dead-weight	3,203	3,123	3,500
Full-load displacement	6,175	5,900	5,100
Percentage dead-weight to full-load displacement	52	53	68 6



CONCRETE FRAMING IN 3500-TON CONCRETE SHIP. ADAPTATION OF SIMPLE BEAM AND SLAB DESIGN

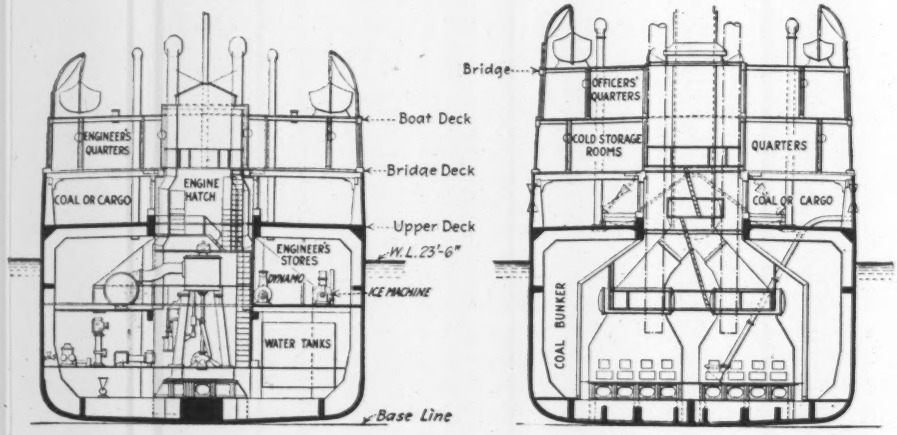
In the general shaping of the hull very little change from the standard wood ship has been made as a concession to the use of concrete. The midship section, which continues for about 35% of the length, is practically square. There is a slight batter in the bridge-deck bulwark and a rise of 9 in. in the bottom from the center to the bilge keelsons.

Stiffness of the bottom is aided by one center keelson and two bilge keelsons, the former turning to make stern and stem posts and the latter following the curve of the hull and ending at the collision bulkheads. These keelsons are concrete girders reinforced with rods in their upper and lower sections and tied together with frequently spaced stirrups. They frame into the transverse frames of the vessel, which are spaced 5 ft. apart on centers. These frames are reinforced-concrete girders turned at the corners to meet the curve of the hull and reëntering at the main deck to form the transverse deck girders which carry the deck and serve as cross-braces for the side members of the frames. The bridge deck bulwark is in effect a continuation upward of the shell of the ship, being formed of girder frames and an outer shell. It is provided with an expansion joint about amidships. The main frames are additionally stiffened by longitudinal, horizontally placed stringers about three-quarters of the way up the frame.

Integral with the main frames is the shell, a continuous, reinforced-concrete plating 5 in. thick on the bottom and up to a point 6 ft. above the base line, and 4 in. thick through the remainder of the hull to the deck line. The main deck is also a 4-in. reinforced-concrete slab continuous except for the hatch openings, which are stiffened by the usual combings.

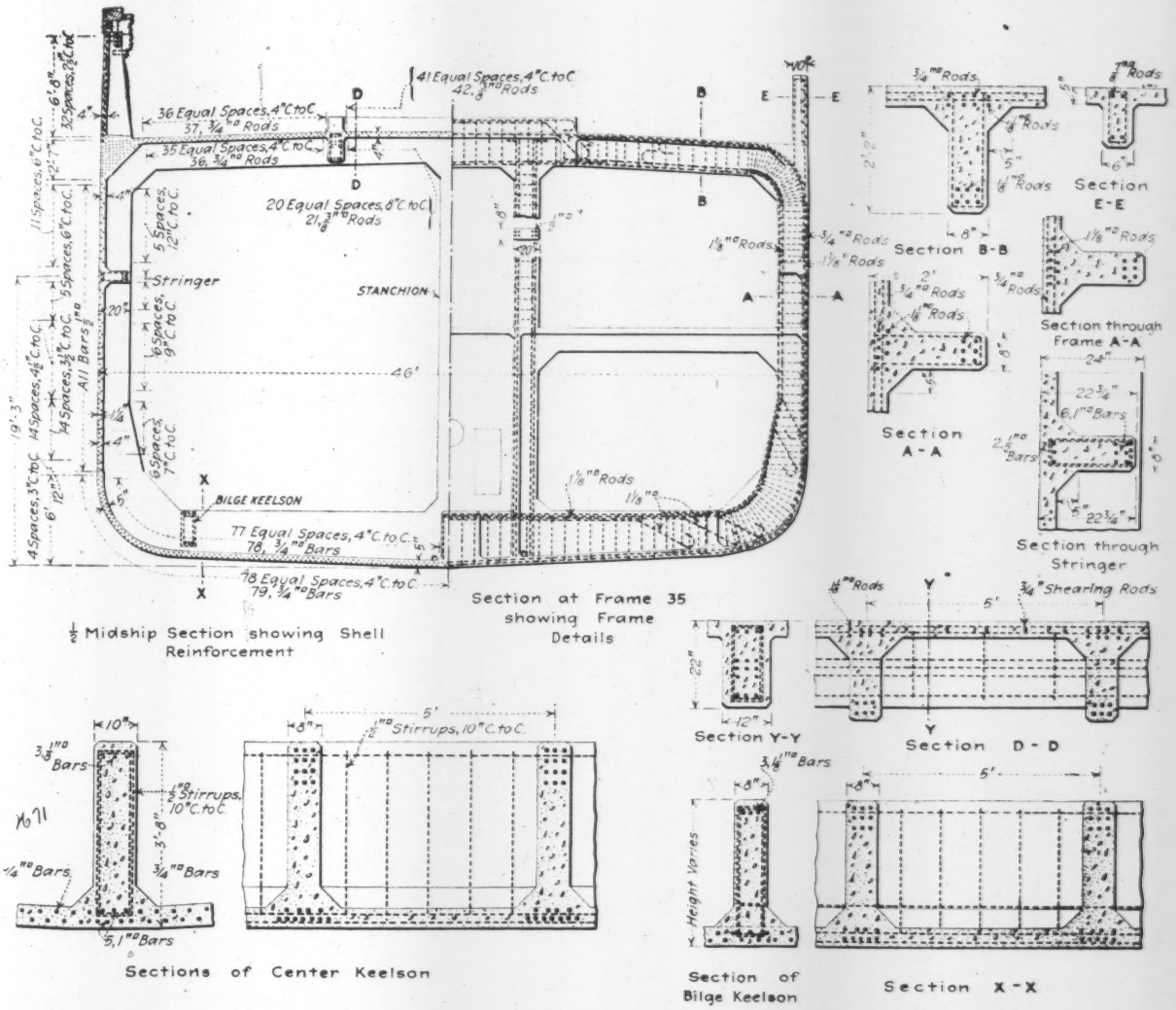
The shell is reinforced at its outer and inner faces with ½- to ¾-in. square bars running around the shell parallel to the water line and spaced at distances varying from 4 to 12 in. c. to c., as shown on the cross-section drawing. These rods are designed to be placed 1¼ in. from the face of the concrete on both outer and inner faces.

In addition, there are vertical ¾-in. shear bars between the horizontal rods spaced on varying centers. They extend around the entire shell and deck. The detail, a heavy connection forming in effect a longitudinal girder between the shell and the deck, is shown in one of the drawings.



TWO CROSS SECTIONS OF THE GOVERNMENT'S 3500-TON CONCRETE SHIP

Between hatches in the cargo holds the deck beams have intermediate supports in the way of reinforced-concrete stanchions designed as columns, these stanchions being braced longitudinally at about half their height with reinforced-concrete struts. In the stern half of the boat the shaft tunnel is of reinforced-con-

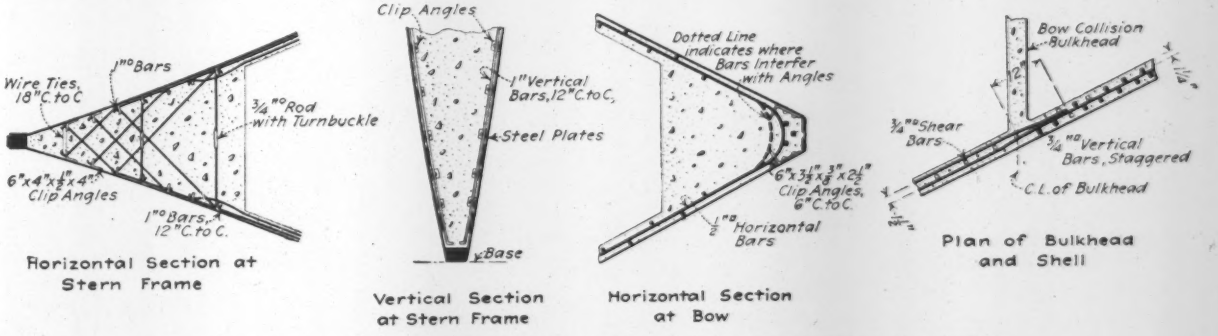


CROSS-FRAMES AND SHELL SLAB IN ONE OF THE AMIDSHIP SECTIONS OF CONCRETE VESSEL

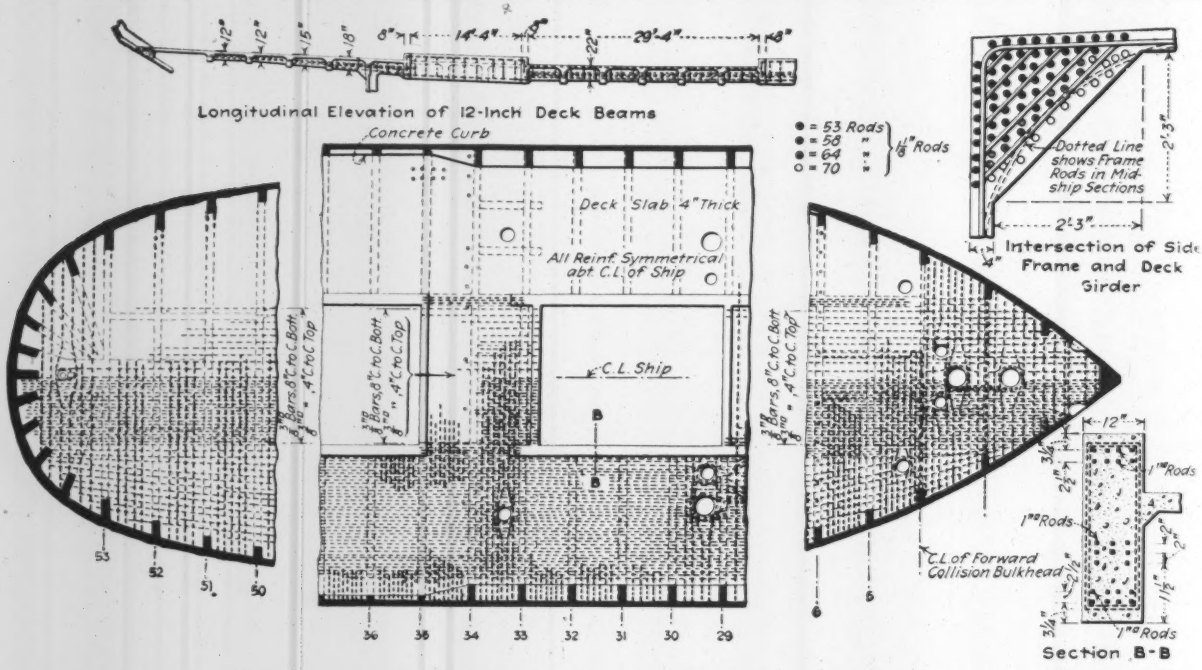
crete framing and the stanchions are supported on the crossbeams in the shaft-tunnel roof, which in turn span between short posts on either side of the tunnel.

Foundations for the engines and the boilers are on steel plate girders footing on an extra framing of longitudinal reinforced-concrete girders running parallel to the keelsons.

Four transverse water-tight bulkheads are provided. Two are collision bulkheads near the bow and the stern, and two inclose the engine-room space. Details of these bulkheads are given in one of the drawings. They consist of concrete slabs reinforced with transverse and longitudinal steel, and backing against vertical stringers and beams which frame into the main frames and deck girders. The engine-room bulkheads are slabs stiffened by vertical beams extending from short


Wire Ties, 18"C. to C
1" Bars
¾" Rod with Turnbuckle
6"x4"x½"x4" Clip Angles
1" Bars, 12"C. to C.
Horizontal Section at Stern Frame
Clip Angles
1" Vertical Bars, 12"C. to C.
Steel Plates
Base
Vertical Section at Stern Frame
Dotted Line indicates where Bars Interfer with Angles
6"x3½"x3"x2½" Clip Angles, 6"C. to C.
½" Horizontal Bars
Horizontal Section at Bow
Bow Collision Bulkhead
¾" Shear Bars
¾" Vertical Bars, Staggered
C.L. of Bulkhead
Plan of Bulkhead and Shell

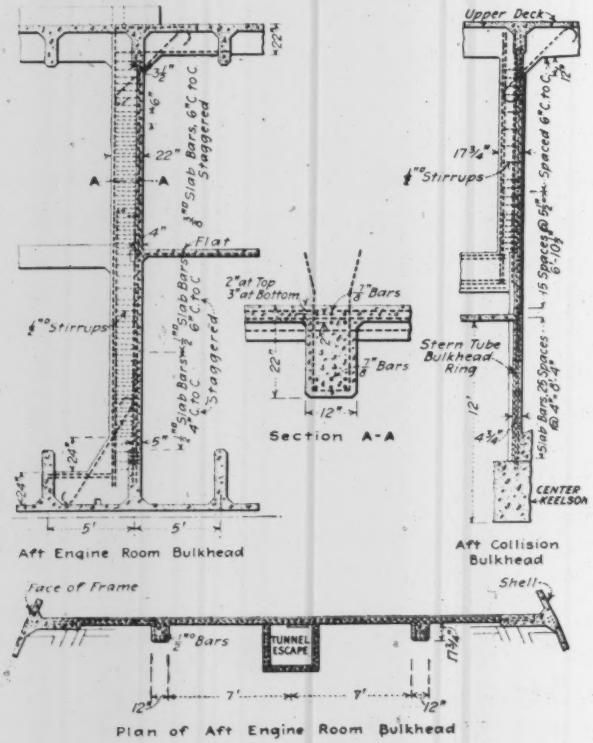
EXTRA HEAVY INTERLACED REINFORCEMENT PROVIDED AT STEM AND STERN


Longitudinal Elevation of 12-Inch Deck Beams
Concrete Curb
Deck Slab 4" Thick
All Reinf. Symmetrical abt C.L. of Ship
C.L. Ship
● = 53 Rods
● = 58 "
● = 64 "
○ = 70 "
⅛" Rods
Dotted Line shows Frame Rods in Mid-ship Sections
Intersection of Side Frame and Deck Girder
C.L. of Forward Collision Bulkhead
Section B-B

MAIN DECK REINFORCEMENT AND DETAILS SIMILAR TO ORDINARY REINFORCED-CONCRETE FLOOR

stringers in the bottom between two frames to similar stringers framing into the deck beams.

A special effort has been made to avoid sharp turns in the steel reinforcement, particularly in the main frames which are turned on long radius curves. Steel reinforcement in the hull will be ½ and ¾ in. in diameter. Larger rods, as shown in the illustration, are in the interior framing. All reinforcement will be continuous, though the exact method of insuring this continuity has not yet been decided. Neither has the exact nature of the aggregate been settled, although experiments have been made with various light-weight aggregates which seem to promise a possibility of a concrete weighing less than 110 lb. per cubic foot with a strength of 4000 lb. per square inch at 28 days.



BULKHEADS DESIGNED TO TAKE FULL HEAD OF WATER INSIDE HULL OF THE VESSEL

An analysis of the ship to determine its stability shows that the metacentric heights in the light and full-load conditions are respectively 2.15 ft. and 2.2 ft. This is well within the limits of present practice for vessels of this type and size. The freeboard amidships at the side is 4 ft. 9 inches.

As this is a seagoing vessel, it has to be analyzed to take care of the extreme condition of a ship in open ocean. Standard practice for the longitudinal analysis has been followed; that is, the same basic assumptions as to length, depth and form of wave and the same method of procedure as is standard in analyzing steel ships was followed throughout. Hogging and sagging analyses were made for five conditions of load and sea. The strength of the ship's shell was determined, analyzing the ship as a hollow beam with tension and compression going to the bottom and deck. The results of the analyses are shown in Table II. The strength of the shell plating as a slab spanning the frames was considered in combination with longitudinal flexural stresses. The Concrete Ship Department made analyses of the frames for conditions due to different loadings of the hull and to transverse rolling. This transverse section was designed to stand outside water pressure with water to the gunwales and with minimum cargo load, with maximum cargo load and a sagging draft of 15½ ft., and in listed positions with loading both light and heavy.

For all these conditions of loading the frames were

designed to have stresses not to exceed 16,000 lb. per square inch in the steel and 1500 lb. per square inch compression in the concrete. Bulkheads were designed to carry a head of water on either side up to deck. The collision bulkheads fore and aft were designed for 1500 lb. per square inch in the concrete and 16,000 lb. per square inch in the steel. Steel stress in the engine-room bulkheads was advanced to 20,000 lb. per square inch. The deck was designed to carry 5 ft. of water or its equivalent, which is somewhat in excess of the loading on the decks of standard steel ships being built by the Emergency Fleet Corporation.

Extra strong and a more plastic concrete is expected to be achieved by the use of a specially fine cement. Any standard portland cement which will meet the Government specifications may be used, provided the fineness is increased so that at least 90% will pass a No. 200 sieve. This is hoped to give a concrete of 4000 lb. per sq.in. compressive strength at the end of 28 days.

TABLE II. STRESSES IN GOVERNMENT 3500-TON CONCRETE SHIP

Condition	Maximum Bending Moment Foot-Tons	Maximum Tons per Sq.In. Fiber Stress in— Deck Reinforcement	Keel Reinforcement	Pounds per Sq.In. Fiber Stress in Concrete
Ship without cargo, hogging	25,175	5.53	2.80	728
Ship fully loaded, hogging	37,000	5.63	2.95	766
Ship without cargo, sagging	14,400	1.28	2.63	270
Ship light with enough cargo in forward hole to trim sagging	11,960	1.07	2.19	210
Ship fully loaded, sagging	9,400	0.84	1.72	70

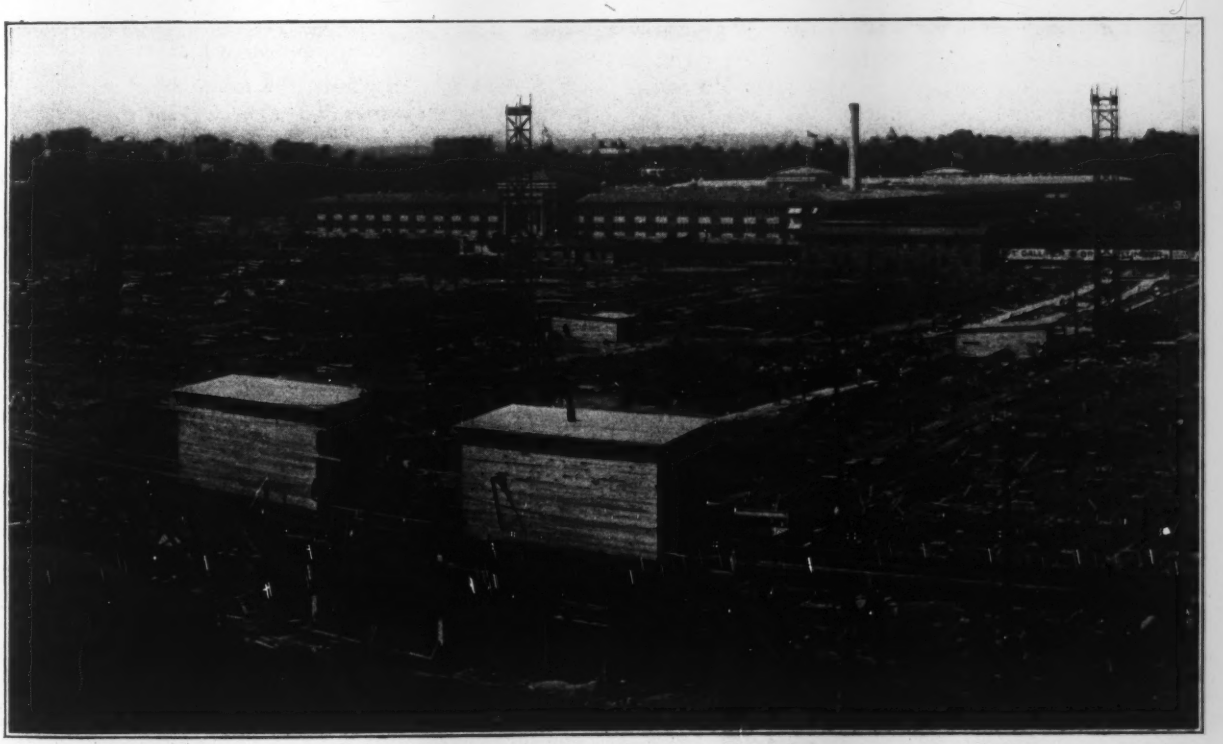
With a standard 150-lb. concrete it is estimated that the ship will contain 1761 tons of concrete, 400 tons of reinforcement steel and 811 tons of wood, fittings, machinery and equipment, making a total of 2970 tons, as shown in Table I. That is, the steel in the reinforced-concrete ship will be about one-third of the amount of steel in the steel ship of equal capacity.

Long Trestle Controls Concreting on Big Office

Mammoth New Buildings for Army and Navy Have Eight Mixing Plants, Each Fed from Separate Bins

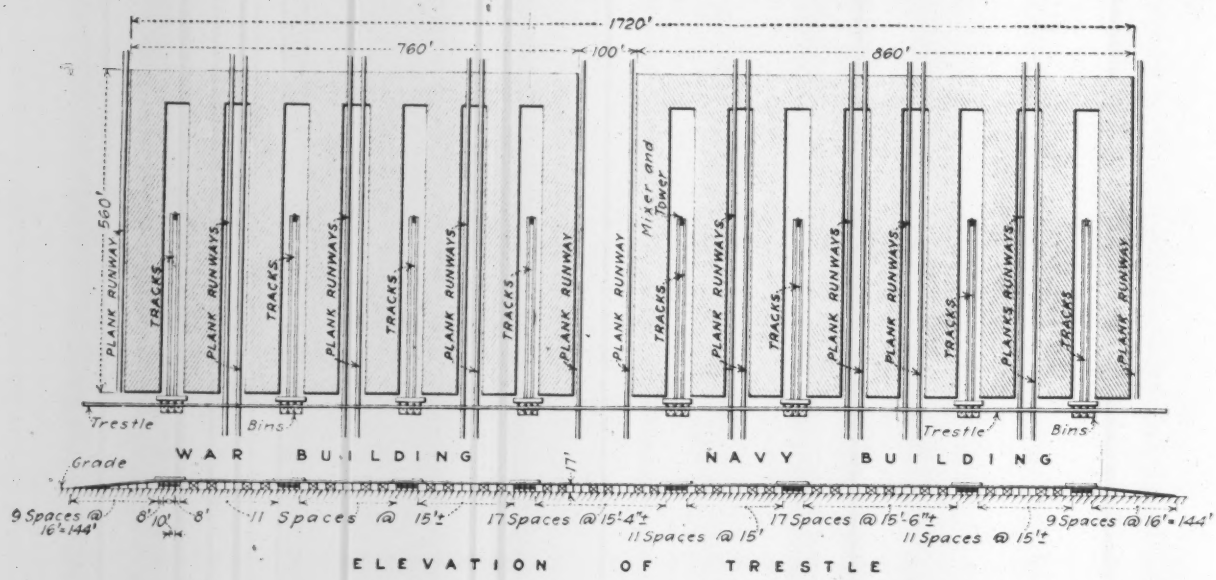
CONCRETE materials for a large building now under way in Washington are being delivered to the site in motor trucks which run over a long trestle paralleling the bulding. They dump at eight points into storage bins spaced under the trestle opposite tracks leading to eight mixing plants which control the entire area. The group of two reinforced-concrete buildings of unprecedented ground area is being built as one operation for use as offices for the War and Navy Departments. It comprises virtually a head house 60 x 1720 ft. in plan, with 17 wings extending 500 ft. in the rear, making a total area to be covered of 1720 x 560 ft. The buildings are to be only three stories high, but they will have a floor area of 1,800,000 sq. ft., the largest yet attempted in one operation, though some of the coming army terminal warehouses will surpass them in that respect, on account of their greater height. In Washington, the main problem lay in the difficulty of distributing the concrete over so extended a ground area.

The trestle is of exceptionally heavy timber construction, capable of carrying the 5-ton motor trucks which deliver the concrete materials to the bins along the line. It is 2200 ft. long and 17 ft. above the ground. with approaches on an 11.8% grade from the streets. The loaded motor trucks bring sand and gravel from nearby river dredgings, and cement in bags from a railroad siding at one end of the site, pass up the



TRUCK ON TRESTLE IS ABOUT TO DUMP CONCRETE AGGREGATE IN STORAGE HOUSE

cast approach, run over the trestle, and after dumping where the materials are required pass off the west incline to the street. This permits a steady procession of such trucks, in no way interfering with one another in their trips across. It has been found that the approaching grade is just about as high as the loaded truck can make without difficulty.



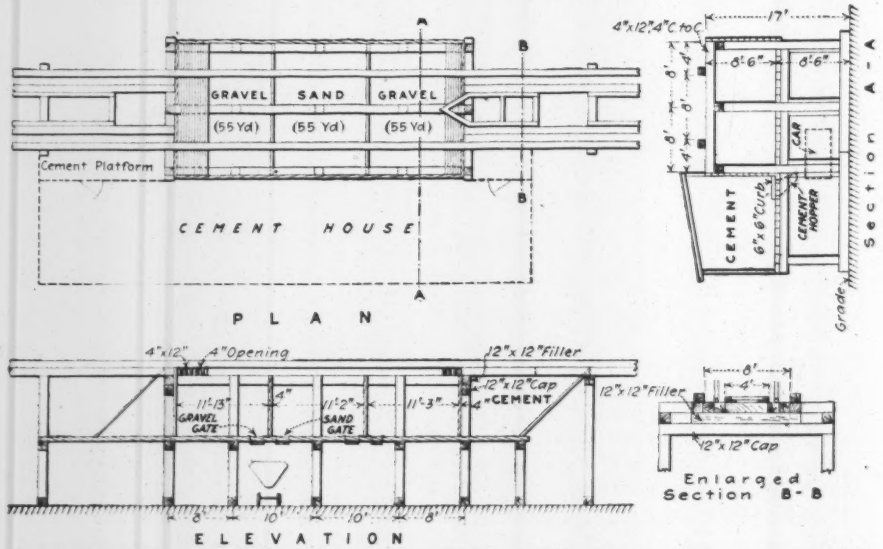
MOTOR TRUCKS DELIVER CONCRETE MATERIALS TO EIGHT MIXING PLANTS OVER TRESTLE 2200 FT. LONG ON ARMY AND NAVY OFFICE BUILDINGS AT WASHINGTON

For the most part, the trestle is built of heavy timbers lent for the purpose by a local underpinning and house-moving concern, and they will be removed but little damaged when the work is done. Sticks of 12 x 12 in. timber form the uprights, resting on mud sills, and the stringers, together with alternate sway-bracing, give longitudinal stiffness. As shown in the drawings, a track for the trucks is formed by two 12 x 12's for each wheel, with outside guards of 10 x 10's. Inner guard timbers held apart by braces every 5 ft. or so complete the main floor of the trestle proper.

At intervals corresponding to every other court between the wings of the building are spaced the storage plants, eight in all and alike in design. These provide housed storage for gravel, two bins each of 55 cu.yd. for gravel, a central bin of 55 yd. for sand, and room for cement in a house off line of the trestle. Gratings made by 4 x 12-in. plank on end, spaced to give 4-in. openings, cover the aggregate bins, and the motor trucks dump on the gratings. Cement is brought in sacks and dumped down chutes just outside the main house and is stored in the cement house.

Under each storage house narrow-gage tracks extend at right angles to the trestle into the site. Cars with separate compartments for the sand and the gravel are run under the storage hoppers, and the sand and gravel are allowed to run into their compartments. Cement is thrown in on top and the car, controlled by an endless rope from the engine near the mixer, is moved to the mixer. There are two parallel tracks under duplicate hoppers at the bins running to each side of the mixer hopper.

The eight mixing plants, the locations of which are shown on the drawings, are alike. Each comprises a 1¼ yd. mixer sunk below ground level with an accompanying tower and elevator. Each mixer is driven by a 40-hp. electric motor which also raises the skip.



STORAGE BINS ON TRESTLE TAKE AGGREGATE AND CEMENT FROM MOTOR TRUCKS

A separate motor draws the material cars to and from the bins, a distance of about 300 ft. Concrete is delivered to place in buggies traveling along plank walks for the ground floors, and on walks on the forms for the upper two stories. Connection from the mixer to these floors is made on trestles at each floor reaching from platforms alongside the tower at the respective floor levels. Each plant has a capacity of 400 yd. per day, with 50 men per plant, and as the storage facilities for each plant are separate there is nothing to prevent all eight mixers working at once at a capacity of 3200 yd. per 10-hour day, although the restrictions of construction will probably never permit this. As each storage unit holds only a limited amount a steady supply must be maintained by constant delivery by motor trucks.

On the large insert sheet accompanying this issue of *Engineering News-Record* is a view of the whole site as it appeared on June 10.

The buildings are being erected by the Turner Construction Co. under the direction of the Bureau of Yards and Docks, United States Navy, with Civil Engineer A. L. Parsons, U.S.N., in charge and Civil Engineer O. A. Mechlin, U.S.N.R., as resident engineer.

Engineering Aspects of Government Operation of Railroads Are Broad

Amalgamation Into One National Railroad, and Primary Need for Traffic Capacity to Help Win War Present Problems Never Met Before—Progress to Date Centers Around Work of Budget Committee.

By C. W. Stark
Associate Editor, Engineering News-Record

GOVERNMENT operation of the railroads of the United States has brought the railroad engineer opportunities never before enjoyed. Unification of the railroads under one head has done this. Heretofore the engineer has been obliged to confine himself to his own road, and to modify what was needed in the light of what his company could afford. Now his problems have become national, and whatever is sufficiently needed is to be built. It might seem that the removal of financial restrictions simplified the problem; but there comes in the engineer's responsibility to see that no material or labor is squandered in unessential construction. The railroad administration has organized its engineering work to see that what improvements are needed for winning the war are built. The slogan is—not maximum economy of operation, but maximum capacity for moving traffic for war purposes.

Doubtless, when William G. McAdoo became Director General of Railroads last December he was well aware that the railroads had fallen behind in the matter of improvements, and needed to have a vast amount of money spent on them to put them in a position to handle the abnormal war traffic. At the same time the old test, applied by the individual railroad company, to determine whether a given improvement was required to enable the company to get more business or handle its present business more cheaply, had to give way to the test as to whether the national railroad system needed the improvement to help win the war. Hence the Division of Capital Expenditures was created by the railroad administration, with Robert S. Lovett, director, E. E. Adams, engineering assistant, and F. W. Sercombe, accounting assistant; and the railroads were informed that all capital expenditures exceeding $25,000 must be authorized by the division.

Most of the railroad congestion of last fall and winter was in the East—east of Chicago and north of the Ohio River. The reason for this is no mystery. Most of the factories and munition plants, most of the coal mines, most of the war ports are in the East, hence most of the freight movement was in the East. Furthermore, the East, being nearest the ports, naturally bore the brunt of the shortage of ships, and any defects in terminal facilities were accentuated there; or perhaps it is better to say that superior facilities in the East were needed to overcome the congestion caused by the lack of ships to carry away the goods brought to the seaboard.

Budget Committee Is Created

To help meet the special requirements of the Eastern territory an advisory engineering committee, termed the budget committee, was created. The country had at that time been divided into three regional districts, Eastern, Southern and Western. The Eastern region extended west to Chicago and St. Louis and south to the Ohio, and included the Virginia coal roads. To the budget committee was given jurisdiction over the same territory, reporting to A. H. Smith, regional director. When the Allegheny and Pocahontas regional districts were later carved out of the Eastern region the jurisdiction of the committee was not changed. The committee consists of Francis Lee Stuart, consulting engineer, chairman; A. T. Hardin, vice-president of the New York Central R.R.; A. C. Shand, chief engineer of the Pennsylvania R.R., and H. A. Lane, chief engineer of the Baltimore & Ohio Railroad.

In May the budget allowances to the various railroads were announced. They totaled $946,293,828, divided into $445,639,225 for additions and betterments, $482,417,179 for equipment and $18,237,424 for construction of new lines. Two-thirds of this amount goes to the original Eastern regional district, and was passed upon by the budget committee. Representatives of the various railroads went in turn before the committee, and their needs were discussed at length. When the committee reached its conclusions as to the items to be authorized they were submitted to the Division of Capital Expenditures, which in most instances approved the recommendations of the budget committee. The railroad administration has ordered the improvements covered by the budgets carried out with all possible

speed, and also that the companies take up with the Division of Finance and Purchase any difficulties they may encounter in financing these improvements. The $500,000,000 revolving fund provided in the railroad act can be drawn upon for this purpose.

The Half Billion for Betterments

Examination of the published summary of items making up the $445,639,225 authorized for additions and betterments gives some indication of the kind of improvements allowed and the kind disallowed. Additional yard tracks, sidings, and industry tracks head the list in point of size, with a total of $98,661,553; shop buildings, engine houses and appurtenances come second, with $61,979,476; and additional main tracks third, with $47,471,002. All of these are classes of improvements that increase operating capacity—the first and third items by providing more trackage, the second by helping keep equipment in service. On the other hand, many items for additional main tracks were deferred, where the budget committee felt that the objective was not so much increased capacity as economy of operation. Because economy of operation was not the immediate object of the administration, grade revisions, too, were crossed off, unless it was shown that they would enable the lines to carry more traffic. New passenger stations and grade-crossing eliminations were among the projects disallowed as unessential to the winning of the war, and allowances were made only where needed to put in passable shape work already started. Electrification was generally disallowed, on the ground that it would tie up materials and labor needed elsewhere, that it would not greatly increase operating capacity, and that any saving in coal by the developing of water power would be too remote for consideration this year.

The table widely published showing the budget allowances to the individual railroads shows not only a large range in the allowances, but also in the items eliminated. To the New York Central R.R. was allowed $70,672,087, and only $41,000 was dissallowed, whereas from a total of $76,030,461 the Southern Ry. obtained the approval of only $29,113,511. These seeming discrepancies are of little significance. The committee had the budgets under consideration some three months, and some of them were referred back to the railroads several times. In general, the budgets submitted late, after extended conference and correspondence, suffered less than those submitted early. And while the eliminations may look large in some cases, there were also additions "inspired" by the committee. One receivership road which had a monopoly of a rather large and important territory and served it none too well, but which had for years been forced by lack of funds to pare its expenditures down, until this had perhaps become second nature, was asked to resubmit its budget, with large amounts added for engine terminals and shops, and with an item for strengthening its bridges on an important division where the management thought the old ones would do. Where war conditions and congested routes existed along the Atlantic coast, interior routes were opened for additional traffic. Conditions in New England received particular attention in view of the scarcity of bottoms for water-borne business.

All of this analysis of budgets, while rather a large beginning, is only a beginning of the work of the budget committee. The engineering organizations of the several railroads have had their attention concentrated for years on the development of the several properties they served, and can hardly as yet have got rid of their biases toward those properties and their needs. To the budget committee has been assigned the larger task of considering the country's railroad network as one national system, and, disregarding corporate ownership if need be, to weld the system together and effect maximum capacity and facility of operation. Little can be said at present of the changes so far under consideration. Most of them are in the early stages, and will require much study and discussion by the interested parties before they materialize. Something can be said of the general character of those changes, and the way they are being handled.

Considerable attention is being given to our ports, treated as a whole and not merely as the termini of certain railroads. Regional Director Smith, in a report made public two weeks ago, indicated something of the possibilities along these lines when he mentioned as reform measures already initiated the common use of terminal facilities at large commercial centers, and the coördination of harbor facilities at New York. These things cannot be completely accomplished without exhaustive study.

The Port of New York

The port of New York alone offers a fertile field for study. A first step has already been made in the diversion of Baltimore & Ohio through passenger trains from the Jersey Central terminal in Jersey City to the Pennsylvania Station in New York. This involved no engineering difficulty, as the physical connections were already there; and a similar diversion of Lehigh Valley traffic will be equally simple. The budget committee aims to do more than that, however. It holds the theory that while suburban traffic should not be disturbed, for the reason that suburbanites have usually chosen their homes because of convenience to certain points in New York, through passenger traffic from New Jersey should be concentrated and brought into the heart of New York—that is, into the Pennsylvania Station—and as much trackage as possible released for freight service.

In some cases this can be brought about easily, Jersey Central trains from Philadelphia and from Scranton can follow the route now taken by Baltimore & Ohio trains, while the proximity of the Delaware, Lackawanna & Western to the Pennsylvania for a short distance east of Newark affords a ready way to take care of Lackawanna traffic. On the other hand, the Erie, the West Shore, the New York, Ontario & Western and the coast lines of the Central of New Jersey offer the committee no small problems.

Other Atlantic ports are being studied in a similar manner. Coöperating with the Division of Operation, which is already, as noted in Mr. Smith's recent report, diverting traffic to less congested routes and to lines with more favorable grades, redistributing motive power as needed, and eliminating unessential passenger service, the committee is studying ways of strengthening weak links of existing routes by more sidings and

the like, or of eliminating them and creating new routes by combining parts of existing and formerly competing lines. Certain secondary lines may be linked up to form important belt lines, if plans contemplated go through. The general purpose of the committee is to segregate freight and passenger traffic, eliminate duplication of service and unnecessary mileage, and put each bit of railroad to its best use, regardless of its ownership. More attention will also be given to new lines and extensions when the reinforcement of existing lines is farther advanced.

How the Studies Are Made

All details of the committee's investigations are handled by the engineering departments of the railroads. The committee has no organization to handle these details, and makes requests on the roads for whatever plans and estimates it needs. The chairman of the committee devotes most of his time, however, to the committee's affairs. His experience as former chief engineer of two of the four trunk lines to Chicago, and that of the other three members of the committee, who occupied positions in the active service of three of the largest Eastern trunk lines, give the committee a broad understanding of the whole railroad situation and enable it to initiate a large percentage of the studies being made. The railroad engineering departments are also instructed to look beyond the boundaries of their own companies and make recommendations leading to more nearly complete unification.

To date, as far as outward evidences show, the possibilities of this broader railroad engineering have only been touched. The way has been pointed out, and the plans and estimates called for by the committee from time to time will help those with vision who have to prepare them to work independently along the same lines. The railroad act and the railroad administration assume that Government operation is only for the period of the war. That the old competitive system is to be restored is open to doubt. If, as seems more likely, it is to be replaced by a regional plan of private operation, the work being done at present will fit exactly into such a plan. The railroad civil engineer of the day has a splendid field for his endeavors.

Army Leads in Waste Prevention and Utilization

Conservation and Reclamation Division Stimulates Economy, Prolongs Life of Materials by Repairs and Salvages Wastes

CONSERVATION to the utmost, then the greatest possible reclamation of unavoidable wastes, is the object of the conservation and reclamation division of the Quartermaster Department of the United States Army. All materials and supplies used by the Army are being conserved—food, hats and caps, uniforms and other clothing, shoes, tents, cots and bedding. When conservation can do no more, reclamation of wastes begins—bread, meats, grease, bones, leather, rubber, metal of all sorts, wood, tin cans, bottles, paper, cloth, dead animals, manure. Conservation of hats, caps, clothing and shoes includes repairs, for which special shops are maintained. Dry cleaning of clothing and laundry service are conducted on a large scale. The laundry charges to officers and men are far below those which prevailed under private service—which is not permitted where camp laundries are maintained.

Organization Extends from Washington to Camps

Military organization, centered in Washington, extends through the various sections which handle garbage and waste disposal, salvage of metal, leather, etc., repairs of clothing, and operate laundries. Each camp has a conservation and reclamation staff. By these staffs and in special schools at some of the camps men are trained for conservation and reclamation service, both in the United States and overseas. Incidentally, the authorities have in mind much vocational training which will be useful to the country at large after the war. Men disqualified for fighting are utilized at repair shops. Wives and mothers of soldiers are employed.

Commanding officers impress upon their staff and troops the importance of (1) conservation through care; (2) turning in clothing, etc., for repair before it is too late; (3) saving all wastes for reclamation. Thus, each unit commander must see that all shoes belonging to his command are inspected weekly and, when in need of repair, that they are properly cleaned and then turned in to the shoe-repair section.

Records Kept to Insure Efficiency

To insure the greatest possible economy, records on a strictly comparable basis are kept—not merely for each camp, but also for smaller units, such as men's kitchens. For example, all meat is weighed before use, and as a check against waste a separate record is kept of the corresponding weights of (1) trimmings and condemned meat; (2) cooked grease, and (3) bones that appear in wastes. By this means kitchen can be checked against kitchen and camp against camp, reasonable wastage and salvage determined and emulation secured.

Gardening is a branch of the division which it is hoped will eventually utilize all available land at each reservation. This year some 3000 acres are under cultivation.

Garbage and Refuse Utilization

Millions of pounds of garbage and other refuse are produced at the camps each month. This material is collected by the Government. The garbage from the 16 National Army camps and from many of the National Guard camps is sold to contractors at central loading stations, and is either fed to hogs or else reduced; mostly the former course is followed. Manure and other wastes at some of the camps are also sold. When the various camps went into operation in 1917, prior to the organization of the conservation and reclamation division as it now exists, the contracts were let on a variable basis. These contracts expired June 30. Bids for 1918-19, on uniform specifications, were received May 28. A review of a considerable number of the old contracts appeared in *Engineering News-*

GARBAGE AND WASTE REPORTS FOR APRIL, 1918, AT CAMPS AND CANTONMENTS OF NATIONAL ARMY AND NATIONAL GUARD

(All Quantities Are in Pounds)

Camps	Disposition and Contract Price	Fats and Tallows, Total	Fats and Tallows, Per 1,000 Men	Bones, Total	Bones, Per 1,000 Men	Other Garbage, Total	Other Garbage, Per 1,000 Men	Total Garbage, Total	Total Garbage, Per 1,000 Men	All Other Waste, Total	All Other Waste, Per 1,000 Men	All Wastes, Total	All Wastes, Per 1,000 Men
National Army:													
Custer													
Devens													
Dix				76,175	71	1,158,865	1,088	1,235,040	1,160	320,756	301	1,555,796	1,465
Dodge		7,850	11	46,070	60	439,040	531	492,960	638	122,398	158	615,358	797
Funston	$6.00 per kitchen			17,425	20	419,650	491	437,075	511	1,387,125	1,622	1,824,200	2,133
Gordon													
Grant		3,168	3	56,270	60	652,800	697	712,238	760	135,525	144	847,763	906
Jackson													
Lee		7,750	6	7,595	6	514,560	423	529,905	436	240,370	198	770,275	634
Lewis		442	4	4,026	4	1,047,498	1,027	1,051,965	1,031	2,622,953	2,572	3,674,918	3,603
Meade				33,500	36	1,224,205	1,316	1,257,705	1,352	2,714,250	2,919	3,971,955	4,271
Pike						1,397,250	1,605	1,397,250	1,606	3,651,450	4,197	5,048,700	5,803
Sherman				31,600	28	675,009	573	706,000	603	102,100	87	808,100	687
Taylor				57,200	87	616,900	934	674,100	1,021	224,000	339	898,100	1,361
Travis	$3.50 per kitchen			4,500	6	444,000	559	448,500	564	11,100	14	459,600	578
Upton													
National Guard:													
Beauregard	$4.55 per kitchen												
Bowie	$7.60 per kitchen												
Cody	$1.60 per kitchen									13,095	19	130,950	19
Doniphan	$0.42 per kitchen												
Fremont										5,000	11	5,000	11
Greene	$245 garbage			3,000	3	535,800	547	538,800	548	600	1	539,400	550
Hancock													
Kearny	$0.01 per man									5,190	8	5,190	8
Logan	$10.50 per kitchen												
MacArthur	$7.50 per kitchen												
McClellan										45,746	68	45,746	68
Sevier				11,400	13			11,400	13	174,800	194	186,200	707
Shelby													
Sheridan	$0.02 per man			14,760	22	666,600	999	681,360	1,023	30,000	45	711,360	1,068
Wadsworth													
Wheeler				200	3			200	2	31,830	53	32,030	53
Total		19,210	4 8	363,120	29	9,792,168	830	10,174,498	751	11,838,288	628	22,012,786	1,275

Record of Oct. 18, 1917, p. 731. April quantities of garbage and other wastes are shown by the accompanying table, the totals running well into millions.

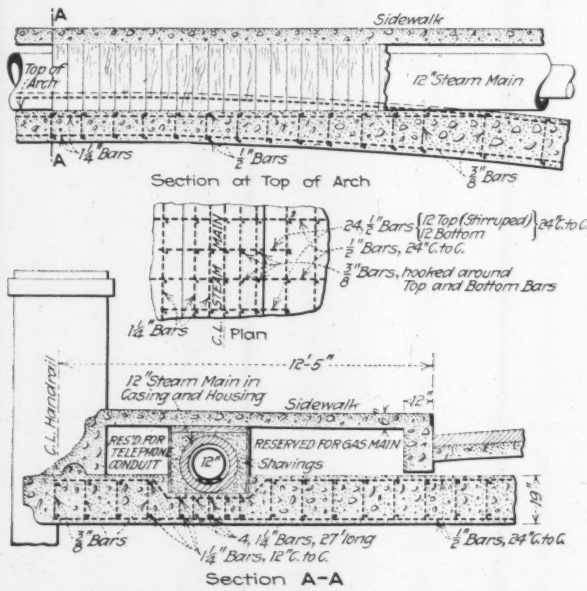
Ten separations of kitchen and barrack wastes are now made, but as two are for weighing purposes eight receptacles suffice. The eight final separations are into (1) bread, which after drying is put in salvaged bags; (2) cooked meat, raw fats and meats, and cooked grease, which after being weighed separately go into one can; (3) bones; (4) other garbage suitable for animal food; (5) table wastes not suitable for animal food, including coffee grounds, tea leaves, egg shells, citron rinds, banana peels and stocks, fish heads and scales, and broken glass; (6) tin cans, which must be washed and rinsed; (7) all waste paper, which must be placed in salvaged bags; (8) empty, unbroken glass bottles and containers, which after being washed and rinsed must be kept in salvaged boxes for weekly collection.

Manure, dead animals and ashes are handled separately, much of the manure being sold to contractors. During April 37,625.5 lb. of manure, nearly all from 11 National Army and National Guard camps, were sold, bringing the Government $14,087. There were also salvaged 548.8 tons of hay, which brought $4371; 190 tons of straw, yielding $62; and 0.4 tons of hides, bringing $66.50. At one camp manure was removed free of charge in April, and at another its disposal was included in the garbage contract. Six camps reported that the manure was burned or destroyed; one, burned or dumped; and two, removed to dump.

Concrete Arch Altered to Carry Pipes

PROVISION for carrying a steam main across the Grand Ave. bridge over the Des Moines River at Des Moines, Iowa, became a necessity after the plans for the concrete-arch bridge had been completed. Space for gas and water mains and electric conduits had been provided under the sidewalks. At the crown of the arches, however, the height of this space was only about 18 in., while the steam pipe with its insulation and housing required nearly 26 inches.

In constructing the arches, therefore, the necessary space is obtained by reducing the thickness of the arch



ARCH IS FORMED WITH GROOVE TO ADMIT STEAM PIPE

ring, forming a groove of sufficient depth and width to accommodate the conduit.

Special steel reinforcement is introduced to give the necessary strength to the arch at this part. The 12-in. pipe has a wood casing and is inclosed in a box packed with shavings. This solution of the difficulty was worked out under the direction of Karl C. Kastberg, city engineer.

Engineers Convert French Beet-Sugar Fields Into Advance Depot

Build Railway Receiving and Classification Yards, Nineteen Warehouses and Balloon Shed—Regulating Officer Controls Train Movement To and From the Battlefront

By Robert K. Tomlin, Jr.
War Correspondent, Engineering News-Record

All Photographs by Engineering News-Record War Correspondent.

NINETEEN warehouses, each 50 x 500 ft., railway receiving and classification yards with 50 miles of track laid and 50 miles more yet to be placed, two steel ordnance structures which sprawl over about seven acres of land, a big balloon shed 180 x 100 ft. in plan, scores of smaller wooden buildings serving as barracks for troops—this is an advance depot and regulating station for the American Expeditionary Forces as I saw it during a recent tour of the places in France where our engineer regiments have been at work. American construction genius has taken a string of beet-sugar fields and in only a few months' time, has converted them into one of the most important railway and freight-handling centers in France.

An advance depot contains, in effect, the pulse of the great arterial system of army traffic whose heart is at our army's docking basins and railway yards on the coast of France, for through it passes the daily flow of food, ammunition supplies and men on their way to the front. Much of our engineering work over here has, until recently, been on paper or in the early stages of construction, but now we have begun to strike our stride, and things are moving rapidly. This advance depot is already a going concern. "It is a job 125% completed," said Colonel B——, the commanding officer of the engineer troops which did the bulk of the construction work, when I called at his headquarters recently. He went on to explain how the original plans have been expanded to one-quarter more than the size contemplated when the job was begun, and how new projects for a big bakery, a power plant and acres of additional covered storage space promised to dwarf the volume of work as first laid out. Look at a map of France and see that the front north of Toul, which the first official announcement stated was being occupied by American troops, is something like 400 miles, in a straight line, from the coast. By the railroad routes over which supplies must be carried the distance is somewhat greater. In these traffic chains which connect our seaport terminals and front-line trenches there are three master links—the so-called base, intermediate and advance depots. At the base depot, I was informed, there must always be on hand, as a minimum, army supplies of all kinds for a long period. The intermediate depot is a supply station for a shorter period, while at the advance depot supplies for a still shorter period must be held in reserve. The names of the depots indicate their relative positions in the scheme of transport and storage. If, for example, something should go wrong at a base or intermediate depot, or on the railway lines running to the advance section, the advance depot could continue making deliveries of all essentials to combat troops for a considerable period. Likewise an accident at the advance depot—a big fire, or damage by an air raid, for instance—would not stop the flow of material to the front, as the intermediate depot reserve would immediately be drawn upon.

The scheme is almost exactly the same as is followed in the design of large water-works systems. For example, in the Catskill Aqueduct system for New York City's water-supply, we have the big Ashokan reservoir, or base depot, at the end of the line farthest from the ultimate consumer. Then, the Kensico reservoir, or intermediate depot, near the city, and finally the Hillview reservoir, corresponding to the advance depot or regulating station, close to the city limits. It is with the advance depot that this article will deal.

In place of a plan showing the relations of the railway yards and warehouses to each other, which, of course, cannot be published under present conditions,

A. THE NINETEEN WAREHOUSES ARE EACH 500 x 250 FEET IN PLAN AND ARE ARRANGED IN SIX PARALLEL ROWS

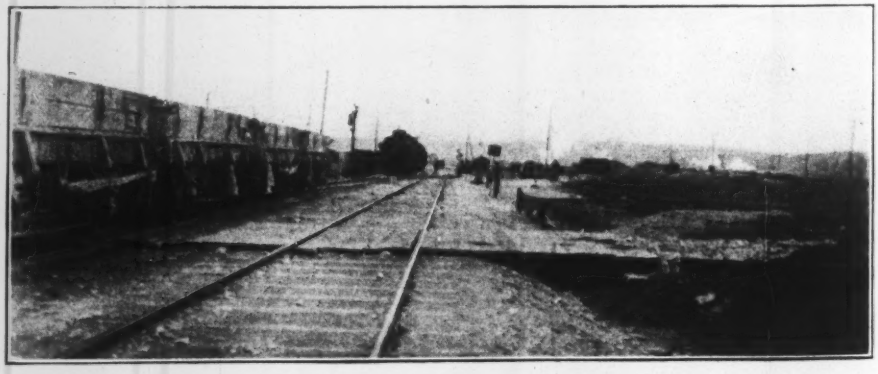
B. AFTER THE WOODEN FRAMEWORK WAS SET UP THE BUILDINGS WERE SHEATHED AND ROOFED WITH CORRUGATED IRON

I must give only a rather vague outline of the layout. The storehouses are arranged in six parallel rows, running north and south, one of these rows, half a mile long, comprising five of the 50 x 500-ft. standard structures. There are two aisles for open storage between the lines of buildings and a third larger open storage space to the east of the last line of warehouses. Along the sides of the warehouses run platforms flanked by lines of depressed track on both the incoming and outgoing sides, as shown in the photographs. The warehouse structures are of extremely simple design, having wood frames sheathed with corrugated iron sheets. The floors are of earth. The several rows of buildings are connected at intervals by wooden drawbridges to permit the handling of freight across the railway tracks. There are in all 14 lines of railway track, such as that shown in Photographs A and B, serving the warehouses and uncovered storage strips.

South of the warehouse group are the main-line tracks of a French railway from which connections have been made to the new receiving and classification yards (Photograph C), which American engineer troops have built to the west of the warehouses. Some distance to the north of the yards are the buildings of the engineer's camp and the headquarters of the commanding officer of the advance depot, while the two ordnance buildings and balloon shed (Photograph D), previously noted, are at the southeast end of the warehouse site.

When the engineer regiment arrived at the site of this advance depot last October it began work on the receiving and classification yards and the diversion of about 1½ miles of existing double-track French railroad, which, to accommodate the new yard layout planned, had to be moved laterally about 400 ft. This job required the removal of about 30,000 cu.yd. of rock by hand-drilling and blasting, as practically no mechanical equipment was then available. In fact, in the early days the engineers made most of their own tools. About 200,000 cu. yd. of earth were removed by hand-labor methods before horse-drawn scrapers arrived. On the railway yard work the American engineers were assisted by a French engineer company. For the 160 kilometers of track in the yards, of which about 70 km. have been laid, 120 km. of rails were received from the United States and 40 km. have been borrowed from the French. For the first unit of the depot it was necessary to provide 700,000 sq.ft. of covered storage and 3,250,000 sq.ft. of uncovered storage. One of the men of the American engineer regiment had formerly been connected with a large building construction company in the United States, and his experience was used to good advantage in organizing and directing the work. It was not until the job was in full swing, however, that the engineer troops began to think about barrack buildings for themselves. Up to Jan. 20 they lived in canvas tents. After that date, however, wooden barrack structures were set up, a water-supply system and two electric lighting plants were installed. In addition, a number of miscellaneous jobs were handled—the placing of plumbing fixtures in nearby hospitals, the building of a medical laboratory, and an extra job involving camouflage warehouses and painting shed.

In connection with the latter job this incident is related: The officer who wanted the work done—it consisted of two 50 x 250 ft. warehouses and a 50 x 250 ft. painting shed—went to Colonel B——, of the engineers, to explain his needs. The colonel agreed to help him. In concluding his interview the camouflage officer said, "Colonel, we would like to keep posted regarding the headway your men are making. If convenient, I should like to receive monthly progress reports." Colonel B——, whose men had become adept at just this kind of work as the result of their experience on the depot warehouse sheds, smiled inwardly in acceding to this request. He set his men to work on Monday morning and the build-

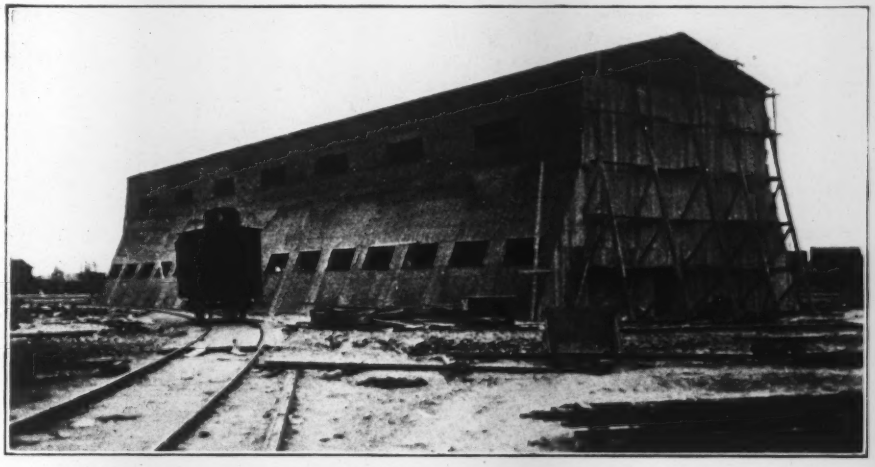


C. THE RAILWAY RECEIVING AND CLASSIFICATION YARDS ARE THE WORK OF AMERICAN ENGINEERS

ings were completed on Thursday of the *same week.* The camouflage officer is still waiting for his "monthly" progress reports.

On the long warehouses for the depot, 500 x 50 ft., the normal time for completing one building was four days. Much of the timber employed on this construction was the product of American forestry companies which are now operating in France. There was nothing elaborate about the job. It was just a case of putting in the base blocks, erecting the timber frames, sheathing the sides and putting on the roof. Later, sheets of corrugated iron were used to cover both the roof and the sides.

After my talk with Colonel B—— of the engineers I met the commanding officer of the advance depot, who has supervision of all activities at this site; the regulating officer, whose exacting duty is the control of all train movements, and the chief supply officer in charge of the load-quartermaster department ing, unloading and storage of supplies. "Our job," the regulating officer explained, "boils down to this: It is to keep the fellows up at the front who are doing the fighting from worrying about regular deliveries of food, forage, material and ammunition. No matter what happens, we've got to get the supplies there and get them there on time."



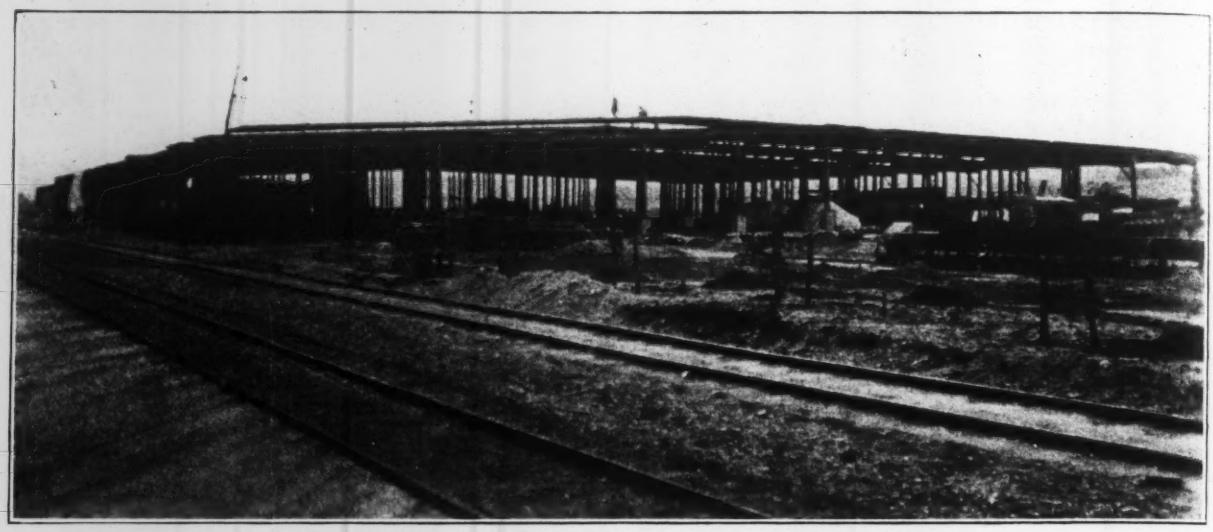
D. THE ENGINEER REGIMENT, ORGANIZED PRIMARILY FOR RAILWAY MAINTENANCE, BUILDS A BALLOON SHED

No one can go through the advance depot and watch the machinery of transportation and storage at work without realizing that the depot commandant, the regulating officer, and the supply officer have a man's size job on their hands. For each combat organization there is a rail-head in the advance zone where supplies from the advance depot are delivered. From the rail-head the army field unit, whatever it may be, is responsible for getting the material to filling points, and thence to the troops, and for this purpose a division, for example, operates its own supply trains, which may be in the form of motor trucks, horse-drawn wagons, light railways, etc. At the rail-heads small reserve stocks of supplies and food are maintained to tide over the non-arrival of a train from the advance depot.

But the regulating officer's duties do not stop with the transportation of supplies and ammunition. He must provide facilities for large-scale troop movements and the delivery of the wounded from the front to base hospitals. The regulating officer, therefore, must keep in close touch with all army activities, not only at the front, but at the ports. For example, he must know the date of arrival of all troopships and supply transports, the character and quantity of their cargoes, the amount of material on hand at the base and intermediate depots, the number of combat troops and their location at the front or in the advance zone, the number of empty beds at each base hospital, the intended movement of forces from one sector to another, and scores of similar data of the most confidential nature. He is one of the few men in France who know the total resources in men and material of the American Expeditionary Forces.

From the very nature of the war-time transport problem, the mechanism of the advance depot must combine properties of great strength and elasticity with the capacity for sudden and tremendous expansion. Even when conditions at the front are quiet the receipt and transmission of supplies and personnel on regular schedule make exactng demands on the organization responsible for this service. Nevertheless, the wires at any time may bring in word of some big activity at the front. Troops must be shifted from one point to another, the supply of ammunition speeded up, supplies diverted from their regular channels, the wounded carried back. These are the times when the advance depot must work at a tremendous overload and it must stand up under the strain—a strain not applied gradually but with the force of impact. In such circumstances, the clamor for railway transportation comes in to the advance depot from all sides, and the depot commandant, the regulating officer, the supply officer and the rest of the staff must keep clear heads and assume the functions of a priority board in the allotment of engines and cars and supplies.

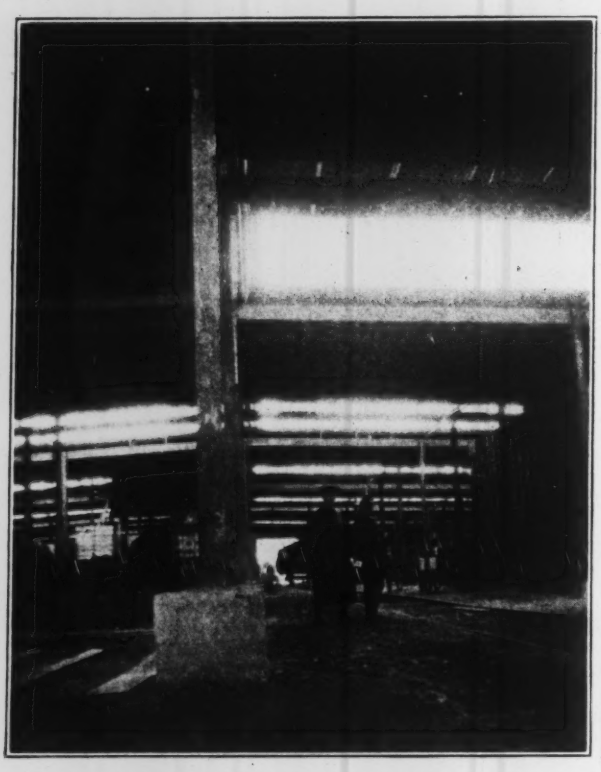
In the ordinary course of events, however, the supplies go forward in what are known as automatic shipments. For example, a certain number of men served by a certain rail-head mean so many pounds of meat, bread, vegetables, etc., every day, and a routine schedule of shipments can be foreseen and established until there occurs a large-scale movement of troops. By keeping a close check on the stock on hand at the advance depot, the amounts available at the intermediate and base depots, and the daily requirements of the troops in the advance zone, it is possible for the regulating officer to exercise a judicious control over the movement of trains and material. Even now, with American man-power here in France far below what it will be ultimately, the advance depot is handling every month something like 20,000 cars (this number including cars arriving, departing, rebilled, loaded or unloaded)—and this volume of business, I may state, is based on data obtained before the German drive developed its present proportions.



E. HOW ONE OF THE STEEL-FRAME ORDNANCE BUILDINGS, THE MACHINE SHOP, LOOKED ON APRIL 5

Everything from the rear en route for the front must pass through the advance depot. Of course, in the case of supplies, not every car is unloaded. Sometimes it suffices merely to rebill a car and send it forward. But with the depot authorities rests the decision as to whether a shipment shall be allowed to go onward or shall be held for storage. In the conduct of this work the regulating officer receives and transmits several hundred telegrams daily, to say nothing of telephone messages in equal numbers.

In the case of troop movements the regulating officer receives by wire a statement as to the number of men, animals and tonnage of material, their present location and their ultimate destination. It is then up to him to get them there. At the time of my visit to the advance depot the regulating officer told me that food and clothing constituted the bulk of the tonnage which he was moving for the American forces. Ammunition, of course, varies from week to week according to the extent of the activity in the battle area. At every railhead the regulating officer has representatives, and every train that leaves the depot for the front carries a representative whose duty is to see that the train arrives at its proper destination.



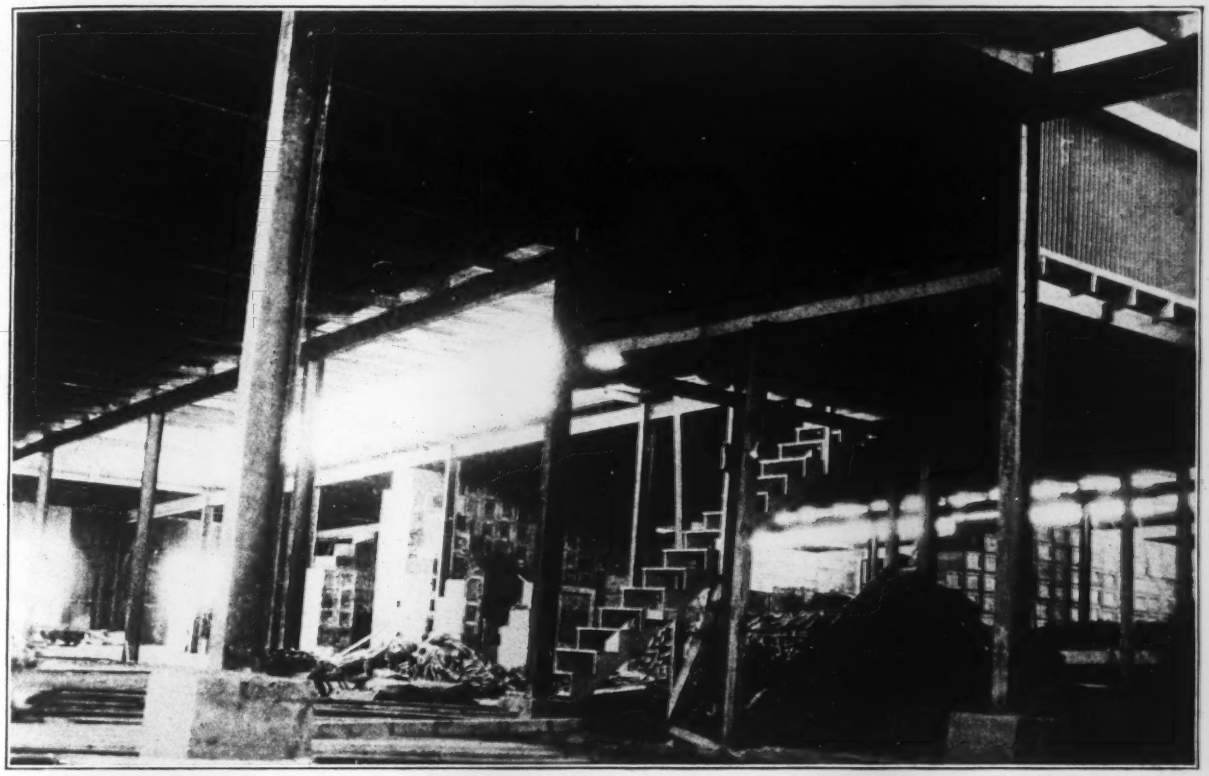
F. WIRE GLASS REPLACES CHEESECLOTH IN THE ORDNANCE BUILDING MONITORS

The actual loading and unloading of cars and the storage of supplies is under the direction of representatives of the quartermaster department, engineer corps, signal corps, medical corps, etc., each department having a certain number of warehouses assigned to it. The quartermaster stores form the largest bulk of freight handled by the depot. They include everything in the way of food, fuel, forage, and wearing apparel, and a good many miscellaneous side lines. The captain in charge of the quartermaster stores, who conducted me through his string of warehouses, receives daily from the regulating officer figures indicating the numerical strength of the forces in the advance zone. Adhering to certain prescribed limits for the Army ration, the warehouse officer loads cars with the proper quantity of supplies for the men, and forage for the animals.

To simplify this task, each warehouse is marked off in certain lengths for different kinds of supplies. Starting at one end, for example, there will be a section for flour, next a section for baked beans, and succeeding sections for tobacco, jam, etc. Other warehouses, are similarly apportioned, there being sections for overcoats, shoes, socks, underclothing, etc.

In the storage scheme the total supply of one kind of material is not put under one roof, but is distributed among several warehouses. Thus, in case of fire, or bombing by airplane, damage to one warehouse unit would have no appreciable effect on the continuity of dispatching supplies from the others.

In the loading and unloading of cars, sections of ball-bearing roller tracks are largely used. Boxes and crates are thrown on the roller track, shoved along the warehouse platforms, and removed at the proper places for car loading or storage. A box car containing 570 cases of baked beans was unloaded, delivered into the warehouse and stacked by three men in 1 hour 35 minutes. Both for incoming and outgoing material a checker is stationed in each car and on each warehouse stack.



G. INTERIOR OF FINISHED ORDNANCE STORAGE BUILDING—COLUMNS SUPPORTED ON CONCRETE FOOTINGS OF DIFFERENT HEIGHTS TO GIVE SLOPE TO ROOF, SINCE ALL COLUMNS ARE OF SAME LENGTH

Records are kept to show output, input and the amount of supplies that is on hand in the advance depot.

After making the tour of the sustenance and clothing warehouses, I examined the medical stores and, finally, the engineer supplies. The latter were all grouped by sections, and among the things I noted were stacks of chicken wire, shovels, wheelbarrows, mining timber, trench flooring, water pipe, demountable barracks buildings, wire rope, hemp rope, carpenters' tools, saws, a few electric generators, water tanks, etc.

In contrast to the wood frame warehouses, with corrugated iron siding, which are such a prominent feature of the advance depot, are the two large steel-frame structures for the Ordnance Department. One, 500 x 240 ft. in plan, which is practically finished, is serving as a storehouse for ordnance material, while the other, 240 x 260 ft., which may later be expanded to the size of the first, is still in course of construction, as shown in Photograph E. It will be used as a machine shop and repair plant. Both of these buildings are part of the big ordnance building project which was described in *Engineering News-Record* of Jan. 3, page 23.

Since that time there have been a number of important changes affecting this work. In the first place, no such extensive layout of buildings at a single site, as was originally planned, has been carried out. Instead, a few units are being built at one place, a few more at another, splitting the job up. Then, too, in the actual construction, there has been a change from the original policy. The firm of Stone & Webster, which designed the ordnance base structures, was to have handled the construction work also. A number of their men were sent to France early this year, and when a final decision had been reached regarding the sites of the buildings, the job was started by them. However, the Army has now concluded to complete the ordnance building project with its own personnel, and at the time of my visit relations with the Stone & Webster organization had been practically terminated.

The storage building, or larger of the two units, was started with Stone & Webster foremen and a detail of 65 men from the ranks of the ordnance service, while the machine shop structure, now under construction, is being built by a detail of infantry—about 100 men—under the direction of an ordnance captain. The engineer company which built the warehouses and yards at the advance depot assisted in the ordnance work by making a 4-ft. earth fill covered by a 3-in. layer of gravel to form the floor of the storage building.

The buildings are of simple design—light steel members with corrugated iron siding. Bolted connections are used throughout, and all columns are of one length, the roof slope being secured by carrying the concrete foot-

for the columns to different elevations (Photograph G). Bays are spaced 20 ft. apart along the longitudinal axis of the building. On the erection work the practice originally was to handle the steel members singly. Later, however, a steel column and rafter were bolted up on the ground and raised by a gin-pole in a single operation. The purlins, however, were all raised by hand. The progress on the 500 x 240 ft. storage building was as follows: Footings completed Dec. 6, 1917; first steel column erected Dec. 29; all columns, rafters and girders placed Jan. 10.

For the roof the original plans contemplated a thin concrete cover over corrugated iron. This scheme had to be abandoned because of lack of concrete materials; two layers of felt and a layer of roofing paper were substituted. Until very recently the roof monitors were "glazed" with strips of cheesecloth. Now, however, a shipment of wire-glass has been received and has been substituted for the cheesecloth windows as shown in Photograph F.

The machine shop building, unlike the one for storage, is to have a concrete floor. When I inspected the work going on one mixer was delivering the concrete into ordinary wheelbarrows which were moved along plank runways to points of deposit on the floor. The progress of the machine shop structure is shown in Photograph E, which I took Apr. 5.

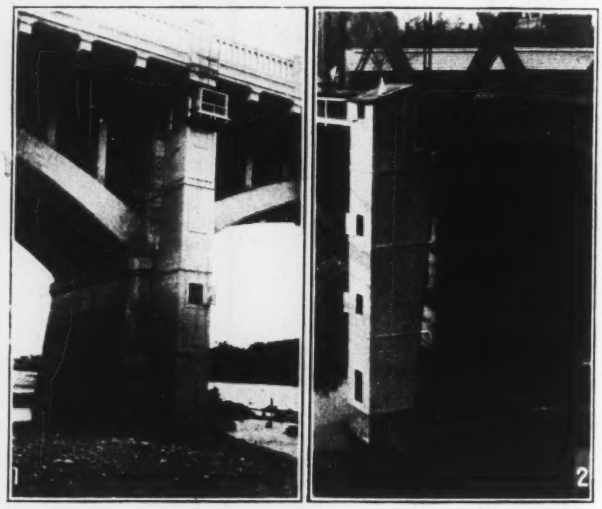
The construction was done under the usual conditions which affected most of our early engineering work in France—difficulties of transport, scarcity of mechanical plant and shortage of labor. Added to these was the fact the job had to proceed in spite of alternate periods of extremely cold weather and rain. For one week the mercury remained at zero (Fahr.) and made it hard for the men who had to handle the steel columns, rafters and girders. Holes worn in their gloves allowed the skin of their hands to come in contact with the cold steel, where it stuck fast and was torn off in patches. Then, in the rainy periods, the fields would become vast seas of mud, and in walking through this tenacious material it was difficult for a man to keep a pair of rubber boots on. The "office," where the administrative end of the job was handled, was opened up in midwinter, and consisted of a canvas tent lighted by a candle. Due to the nonarrival of clips for attaching the corrugated siding to the steel framework, a detail of men was assigned the job of rounding up a supply of wire for this purpose. As a result, much of the corrugated iron siding is now held in place by scraps of wire taken from old crates and boxes and other odd sources. A single small auto was the sole means of delivering food from a town a couple of miles distant. Then, too, few of the men from the ranks of the Army had had any previous experience in construction work of this sort, but owing to the fact that the designers of the buildings had made the work as nearly fool-proof as possible, foreseeing the contingency of erection by unskilled labor—no serious trouble was experienced on the erection work. The officer in charge of the job, appreciating the trying conditions under which his men were working, took special pains to have them supplied with plenty of warm clothing and good food, and this policy was a big factor in maintaining the morale of the force. By the time this appears in print the job will probably have been finished. What these words mean can be appreciated only by those who know of the game fight that has been carried on in midwinter by the ordnance captain and his men, not in the front line trenches, but in the mud and snow of those beet-sugar fields which are now the advance depot.

River-Gages Placed at Bridge Piers

By G. A. Gray
District Engineer, United States Geological Survey, Austin, Texas

WATER-STAGE recorder wells and houses have recently been placed against bridge piers instead of at the usual place on the stream bank. Two such installations have been made by the United States Geological Survey, in coöperation with the Texas Board of Water Engineers, on the Colorado River at Austin and the Brazos River at Waco.

At both stations the installation consists of a reinforced-concrete foundation attached to the downstream side of the bridge pier. The foundation also forms



RIVER-STAGE RECORDERS ORE LOCATED AT BRIDGE PIERS INSTEAD OF BANKS: (1) AUSTIN, TEXAS; (2) WACO, TEXAS.

the bottom section of the well, into which the water is admitted through intake holes. The remainder of the structure is timber and is anchored to the bridge pier by 3-in. angle-iron collars. The interior dimensions of the well and house are 4 x 5 ft. and the corner posts of the well are continued through the floor of the gage house to the roof, thus giving the same construction for both the well and the house. The floor of the gage house is about 40 ft. above low water.

At Austin the station is equipped with a Stevens continuous water-stage recorder and its total cost, including supplies, labor, salaries, expenses of engineers, recorder, and incidentals, was $900. The Waco recorder is of the Gurley graph type and the total cost of the installation was $925.

Local interest in the installation of these water-stage recorder wells and houses was shown by material coöperation by the city of Austin and by the Waco Chamber of Commerce.

War Engineering Photographs from America and the Western Front

Building Port Terminal "Somewhere in America" Requires Enormous Number of Piles

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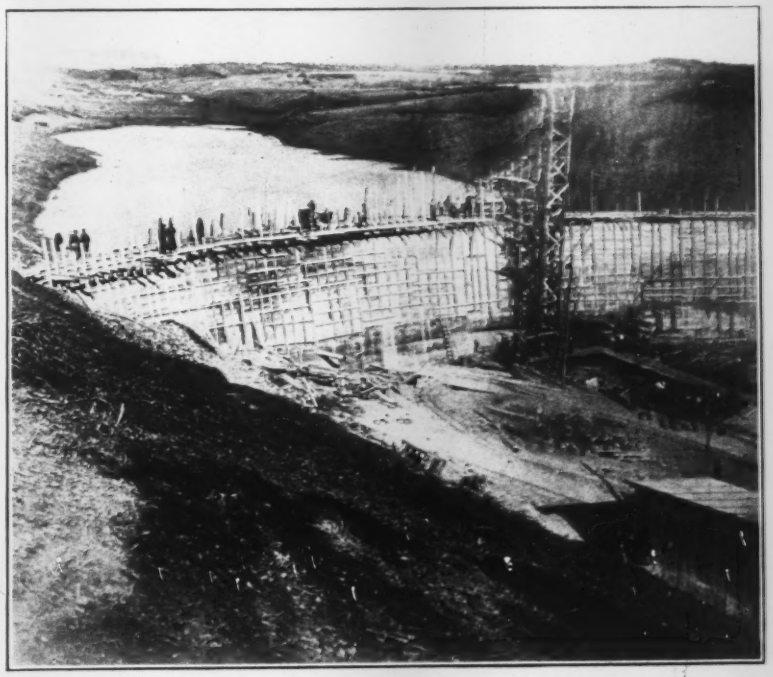
British Driver on Flanders Canal



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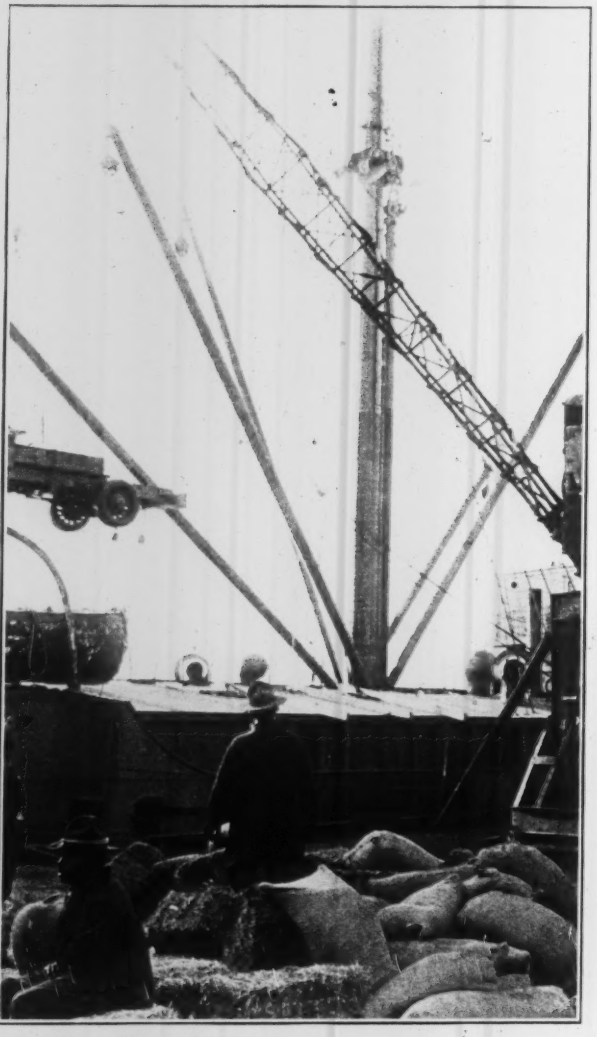
Arch Dam Built By U. S. Engineers Near French Port

Largest Office Building in the World Being Built



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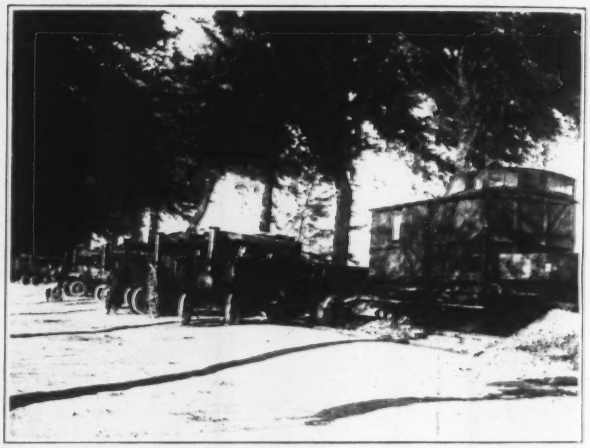
Unloading Motor Trucks in French Port



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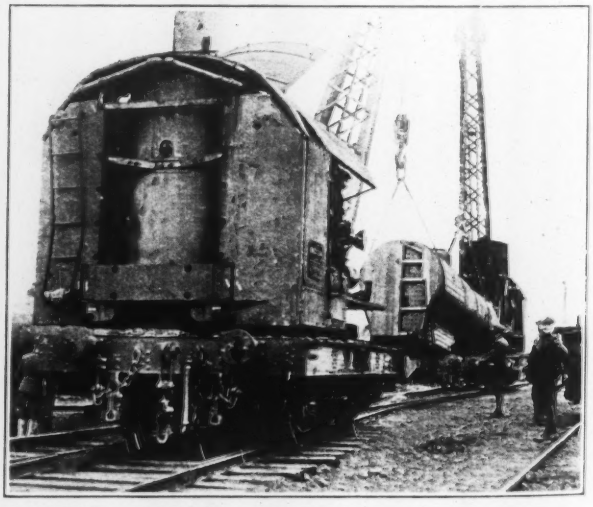
Pneumatic Tired Steam Autos for Road Work—British



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American Cranes Unloading Boiler in France

for the Government in Washington, of Reinforced Concrete in Remarkable Time—Its Construction Is Described In This Issue

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The American Mule Plays a Conspicuous Part in Building Railways Behind the Front

French Official; Committee on Public Information.

Belt Conveyors Help Dig Trenches

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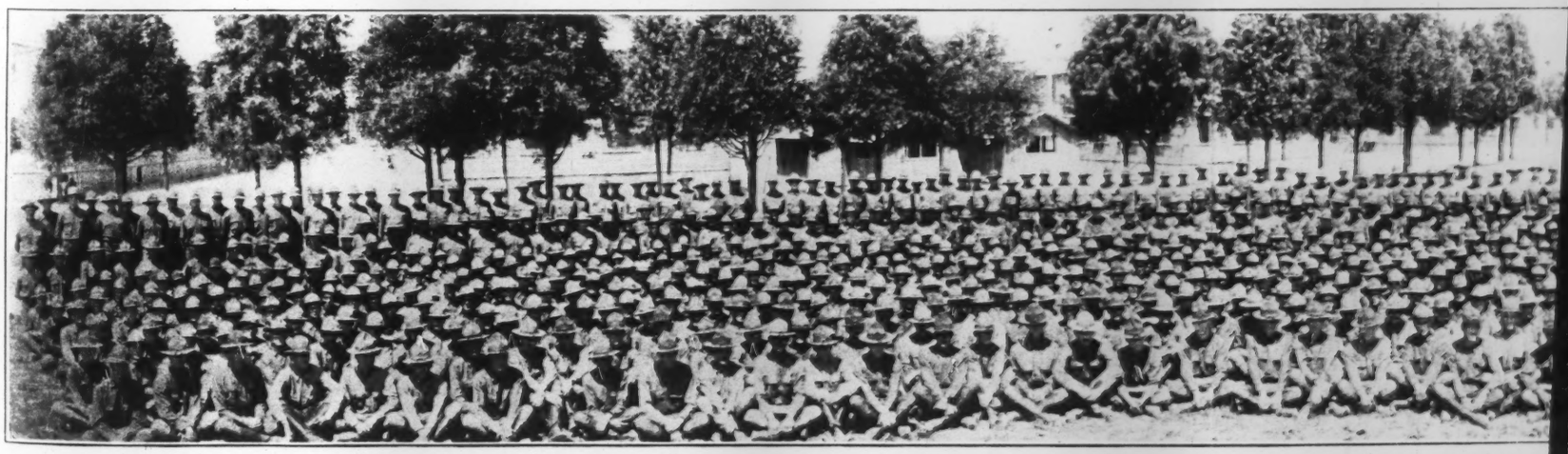
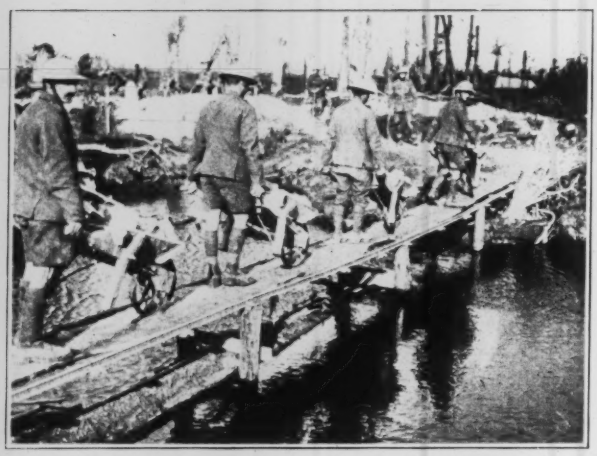
Narrow-Gage Road Makes W



Engineer Officer Students at Camp Lee, Virginia, Whose Training is Described in This Issue, Will Soon Be Engage



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Narrow-Gage Road Makes Wheelbarrow Bridge

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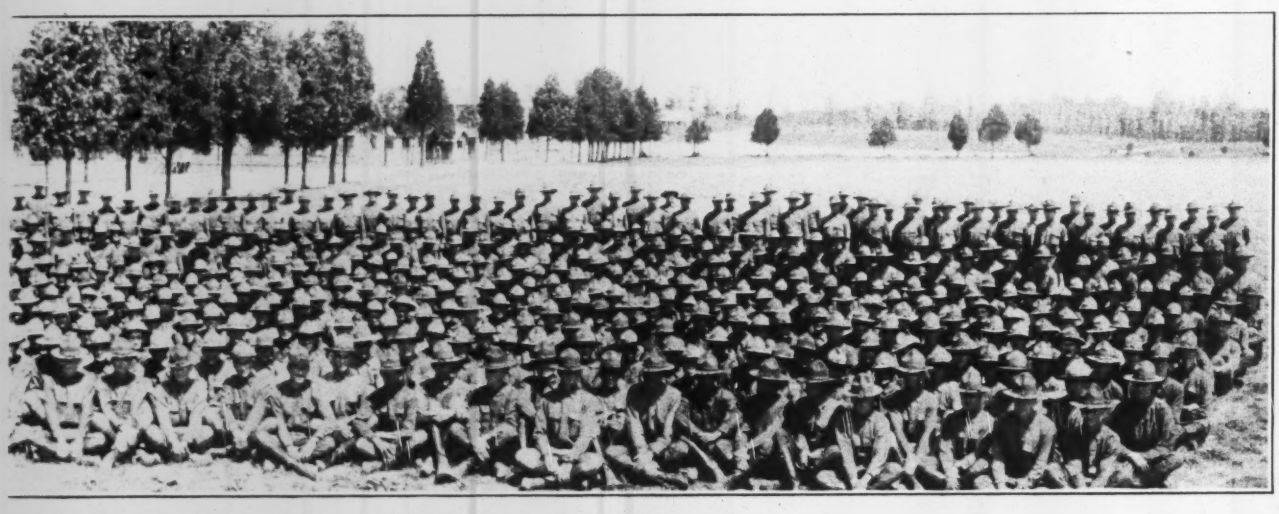
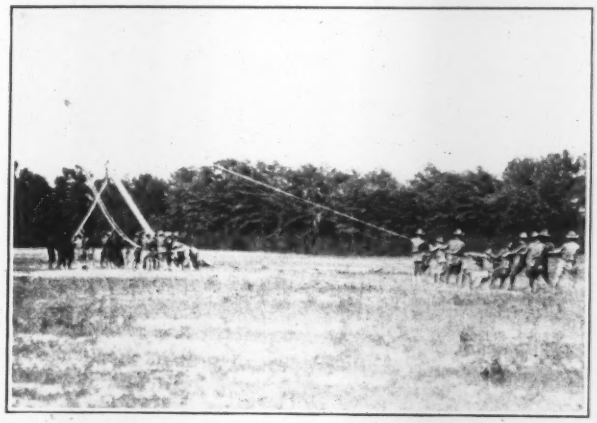
Type of I-Beam Highway Bridge



in This Issue, Will Soon Be Engaged in the Sort of Work Illustrated



Engineer Students Learn Rigging at Camp Lee

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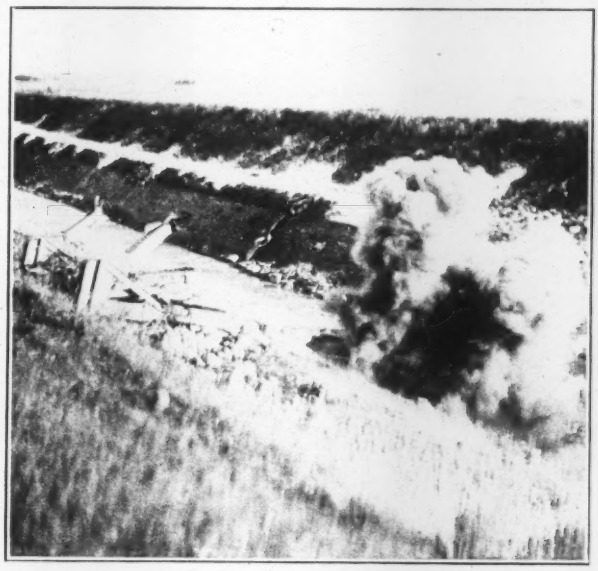
Engineers Bring Up Shells on Push Car



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Clearing Canal du Nord of Wrecked Bridge

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British Engineers Repair Canal Lock

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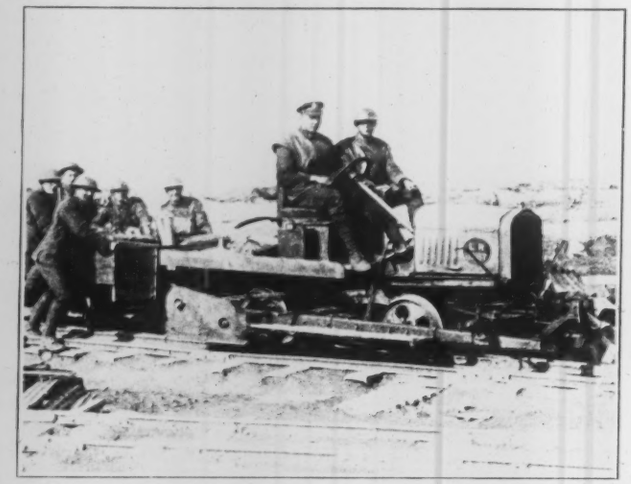
Military Railway Construction in France Often Involves Heavy Work

Shells on Push Car



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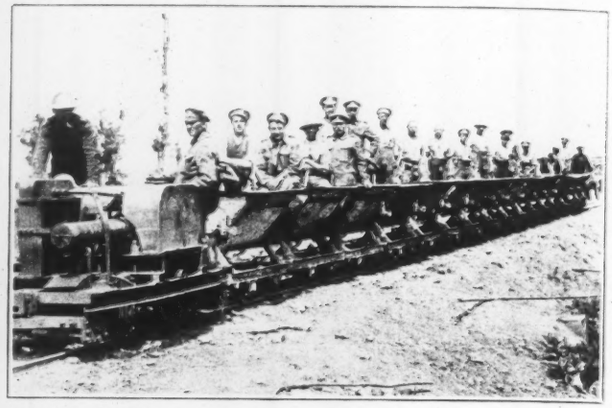
Made from an Old Motor Car by the British



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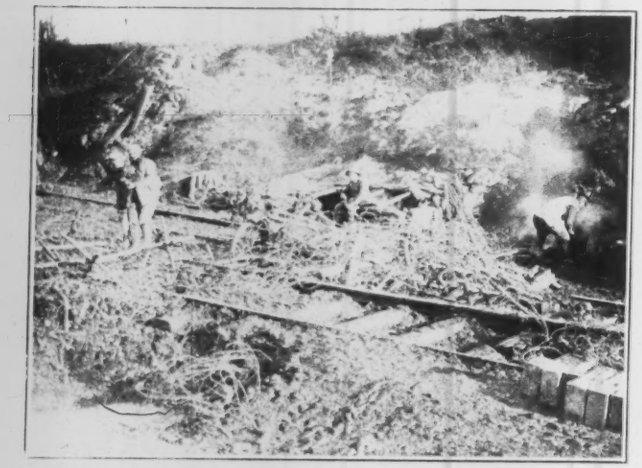
Transporting Work Party by Narrow-Gage

Repair Canal Lock



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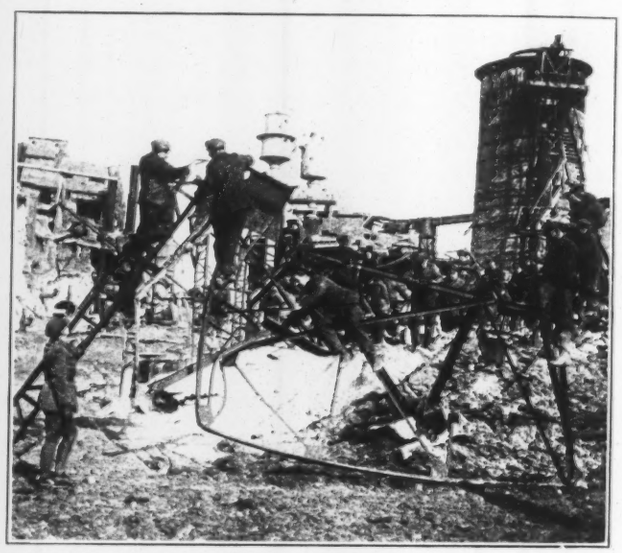
Barricade Across Old Main Line Railway Where It Crossed the German Lines



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Engineers Will Use Every Scrap of Steel From This Wrecked Factory

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What a Few Shells Did to a British Broad-Gage Line Behind the Front

How American Cities Are Meeting War Problems

Coast-to-Coast Survey by City Engineers—Conserving Capital, Labor and Materials—Bringing Records to Date—Planning for Post-War Work

Letter Sent To City Engineers by Editor of Engineering News-Record

In our issue of Jan. 3, we published an editorial entitled "Municipal War Programs Needed." We defined such a program as "a plan of strictly municipal activities and economies that will contribute the utmost in helping win the war," and said that it "should cover at least three and preferably five years" so if happily the war should end soon the program would extend into the period of reconstruction.

What has your city done in the way of framing and putting into effect such a municipal war program? If it has not done anything comprehensive, what has it undertaken in a partial way—as to either the whole field of municipal activities or because not extending beyond the current fiscal year?

Besides a brief off-hand answer to the foregoing questions relating to your city government as a whole, please let us known what special war problems you have met in your own department of the city, and how you have solved them.

Have you been able to keep your engineering staff at full strength, and if not what is its normal and its present quota? If construction work has been slack have you used your staff to bring records down to date and to plan for the future?

The information requested is desired for a survey of how American cities are meeting their war problems. It is hoped that this exchange of ideas will help cities meet war conditions and contribute to war efficiency.

Worcester, Mass.

Not Competing in Money Market. Labor Supply About Exhausted and Wages Practically Doubled—From F. A. McClure, City Engineer.

Activities of this city are largely confined to such work as may be paid for from the tax levy. I do not understand that borrowed money is being used in any but very small amounts, in order to avoid competition in the money market.

The work in general is limited to those public requests that appear to be necessary. The street, water and sewer departments are doing much less work than in ordinary times. The labor market appears to be about exhausted, few if any men applying for public work, while the forces heretofore engaged have dwindled away in such numbers as almost to check works which have been under construction for some two or more years. The pay of laborers has practically doubled, and none but the older men who have been heretofore employed for a number of years are available.

To my knowledge there are no special war problems to be met by this department except to assist in all possible ways in the requests of the general Government, which have been answered in a most generous manner by all classes of people in Worcester.

The engineering staff is not more than two-thirds full strength, not more than twenty assistants being employed at the present time. Quite a number of the former employees have joined the service, and the rest are being employed in the limited municipal activities.

Pawtucket, R. I.

Only Absolutely Necessary Outlays. War Emphasizes Unduly Low Salaries Paid Municipal Engineers—From George A. Carpenter, City Engineer.

Our 1918 program of municipal expenditures was cut to cover only those which we deemed absolutely necessary, but it so happened that there were many things which we considered absolutely essential and our proposed expenditures amounted to a considerable sum. We have not laid out a program covering three to five years but I think that this ought to be done, and especially in our case, for we badly need a large amount of permanent pavement construction.

The war has seriously affected my engineering staff for, while but one man has enlisted three have gone to jobs paying much better compensation than the municipality offers and consequently the city has lost the services of men it has trained. This, it seems to me, is one of the most unsatisfactory and serious aspects of the municipal engineering problem.

Our municipalities, in general, regard engineering services so lightly, from a financial point of view, that there is very little encouragement for a young man to stay in this line of engineering work. It is a great pity, too, because municipal engineering offers such a variety of interesting problems that it should be made financially attractive to capable men. It is a very short-sighted policy, in my opinion, for a city to train engineers in its particular problems and then, when such engineers are in a position to render the very best services to the city, cause these engineers to become dissatisfied with their positions and seek other fields of labor because of insufficient compensation. At the present time our young engineers are comparing their compensations with those of the carpenter, bricklayer, plumber and even the day laborer, and are finding very little encouragement to remain in a profession where education and mental capacity seem to count for so little.

New Haven, Conn.

Doing Only Work Needed to Help Win War. Property Owners Take Bonds for Assessment Benefits—From F. L. Ford, City Engineer.

No definite steps toward the adoption of a municipal war program have been taken by New Haven, but it has postponed many public improvements, and is only doing such work as will contribute directly

or indirectly to winning the war. For instance, we had complete plans prepared for rebuilding the Tomlinson bridge, at an estimated cost of from $500,000 to $600,000. We had plans also for the development and enlargement of our municipal dock to cost $250,000. The issue of bonds for both of these projects has been authorized, but both projects have been postponed for the period of the war and the city has turned over the use of its present city wharf to the United States Naval Reserve for a naval base.

The city has recently approved the layout for a new highway to the railroad station, now being built, at a cost of $400,000 to $500,000 in damages alone for the taking of private property and buildings. The mayor arranged to have all of the different property owners take their benefits in city bonds, so that none had to be put on the market. During the period of the war the city will not attempt to demolish the many buildings on this approach, but will instead collect rents from the different tenants.

So far as paving work is concerned, we are doing a comparatively small amount and are selecting many of the streets with special reference to their military uses, one of those recently ordered being a highway leading up to the Marlin-Rockwell Corporation, which is manufacturing the Browning guns for the War Department. Sewer construction is practically at a standstill.

Rochester, N. Y.

Holding to Absolutely Necessary Work. Unable to keep Engineering Staff at Full Strength—From E. A. Fisher, Consulting City Engineer.

Rochester has restricted its work to such construction and replacement as is absolutely necessary. I know of no special war problems that have been met in this department. We are engaged in the construction of a bridge over the Rochester harbor that is absolutely necessary in order that the proposed terminal docks which the state expects to have ready for use at the opening of the Barge Canal in 1919 may be put in use. We have not been able to keep the engineering staff at full strength. A large number of the men have entered the service.

Niagara Falls, N. Y.

Improvements Kept at Low Ebb. Following Comprehensive City Plan. Shortage of Engineers—From O. E. Carr, City Manager.

Niagara Falls endeavors always to have mapped out a definite municipal program for one year in advance. Beyond one year, our program is less definite, but, in a general way, is extended for two years in the future. In addition, last year we adopted a comprehensive city plan which gives us an outline of municipal development for ten to twelve years to come.

In accordance with the dictates of common sense and the desires of the Federal Government, our municipal improvements have been, throughout the past year, kept at a very low ebb, only those improvements having been made which seemed to be absolutely necessary in order to maintain public health and welfare, and to keep up in a measure with the demands occasioned by the growth of our city.

It has been extremely difficult to keep the various municipal departments up to their full numerical strength. The most serious shortage is in the Bureau of Engineering. Within the past two months, three engineers have been called for Federal service from that bureau and another is subject to call in the first class, which well nigh annihilates the working force in the engineer's office and presents a most difficult as well as an almost dangerous condition—especially when one takes into consideration the carrying out of as heavy a municipal program as will be demanded at the end of the war. We have endeavored to obtain temporary employees in the bureau to keep things running, but the places vacated cannot be properly filled owing to the shortage of young engineers in the country.

Pittsburgh, Penn.

Improved Thoroughfare to New Ordnance Plant on Neville Island Made Necessary. Engineering Staff has 33 Men in Service—From N. S. Sprague, Chief Engineer.

No definite war program has been prepared by the Pittsburgh Department of Public Works.

We have experienced relatively little difficulty in securing shipments of ordinary paving materials, but, like other communities, have suffered from the lack of sufficient man power to complete work expeditiously under contract.

Pittsburgh, being a great industrial center, has been unusually prosperous since the beginning of the European war. This is reflected in the demand of the people for the improvement of streets and the construction of sewers. Last year the total cost of original street improvements exceeded that of the three previous years by approximately $500,000.

The decision of the Government to build an ordnance plant on Neville Island has created the necessity for improving the main thoroughfare leading to the island. The only street from the city by which the island can be reached is very narrow and badly congested. Improvement of this has been under consideration for several years, but was deferred owing to the war with Germany. It is now essential that the work be done at once. It consists of the widening, elevating and improving of West Carson St. from the Point Bridge to within about 460 ft. of Steuben St., about 4600 ft. The estimated cost, including damages to property, is $640,000.

Our engineering staff has suffered greatly by the draft and enlistments, there being a total of 33 men in the Government service. We have many vacancies in various positions and the men are rapidly leaving to accept other positions in connection with work being done by the Government for the prosecution of the war. We are facing the serious question of maintaining the engineering staff. It is already far below the normal quota, with poor prospects of filling the vacancies.

Richmond, Va.

To Assist Government in Any Way It Can—From Chas. E. Bolling, City Engineer.

Exercised by economical reasons and patriotic feelings, our city council made a very small appropriation for the various departments under my charge for the fiscal year 1918. The appropriation for streets was so

small that we feel justified in expending it for general repair work only.

Another reason why construction work in Richmond has been reduced and is slack is due to the high cost and difficulty of getting materials. Many of the quarries, sand and gravel pits have been commandeered by the Government, and we have had great difficulty in getting material to complete work under construction.

Our purpose is to assist the United States Government in every way we possibly can, and sacrifice our own demands as much as possible to aid the Government in the early ending of this terrible war.

We have given up from our regular staff five assistants, all of whom went to training camps or colleges and now have commissions. We have not filled their places. Besides this, we have lost or released six inspectors on our work. Our force for street repair work has been greatly reduced, and we have made no efforts to fill these vacancies, as the demand for labor has been particularly acute for use in cantonments and munition plants near Richmond.

We have a very small force engaged in surveying and platting territory annexed in 1914, covering some 12 or 14 square miles. That force, while small, is absolutely essential for making these surveys, maps, profiles, grades, etc., and preparing plans for a future sewerage system.

Atlanta, Ga.

Expenditure Well in Hand. Water-Works and Paving Extensions to Serve Camp and Fort—From H. L. Collier, Chief of Construction.

It is the policy of the municipality at this time to hold its expenditures well in hand. Since we are in the midst of the war we must yield to Government requirements.

In connection with the War Department, we can report the laying of six miles of water pipe at a cost of $200,000.

Fulton County, in which Atlanta is located, is now constructing about nine miles of asphaltic concrete pavement, connecting Camp Gordon with the city, and the city is repaving Peachtree and Whitehall Sts., connecting links between Camp Gordon and Fort McPherson, with sheet asphalt.

The city is also contemplating leasing from 60 to 100 German prisoners to do street and quarry work for the city.

Savannah, Ga.

How to Increase Revenue Without Bond Issues Being Studied. Bringing Records Up to Date—From E. R. Conant, Chief Engineer.

Savannah completed certain extensive work within the past year, and was more fortunate than some of its sister cities in getting the work done before prohibitive prices for material and labor troubles seriously interfered. We made an expenditure of over $1,000,000 for storm-water and sanitary sewers. We constructed our auditorium and public library just in time.

The comprehensive plan I had mapped out for paving is interrupted for the time being, on account of labor conditions more than the cost of material. Port cities, especially where extensive shipbuilding plants are located, draw from the city practically all the skilled and even ordinary labor.

Although we have necessarily raised wages, all operation work is carried on with serious difficulty. The city administration foresees increased cost of operation for the coming year—or years, should the war continue. This is being carefully considered and meetings are now being held to determine the best method of increasing the revenue by taxation or by extension of the present corporate limits of the city.

As regards my engineering staff, my heavy work of construction ceased at just the right time. All men not needed for the operation of the department readily found situations or went into the reserve corps of engineers. I have all the necessary force required and during the dull period am bringing all records up to date and preparing data to revise our city map.

Whatever available money can be spared after operating the city is to be used principally in improving our system of water-supply. A comprehensive plan for water-works improvement has been worked out and, as soon as conditions permit, work will be taken up.

Birmingham, Ala.

Has Curtailed Public Improvements. Men Who Have Left Engineering Staff All Went Into War Work—From Julian Kendrick, City Engineer.

Early in the war Birmingham adopted the policy of curtailing public improvements as far as possible, and only completing such work under construction as could not be stopped without considerable loss to the contractor or the city. The only work now ordered is of very minor nature, usually consisting of short extensions of sanitary sewers, where recommended by the Board of Health.

The Engineering Department has been reduced to a minimum, and I am glad to say that, without a single exception, the men leaving this office are either in Government employment, or in the employ of industries directly connected with war manufacturing, or have joined the army direct.

As is probably the case in almost every municipality in the country, our great problem is that of labor—it being not only hard to get competent labor, but the scale of wages has so advanced that to undertake new construction is almost prohibitive. This is true as well in regard to materials.

Memphis, Tenn.

Heavy Construction in Past Has Created Maintenance Problems. River Terminal Bonds Voted and Work Probably Will be Undertaken Soon—From Horace H. Hull, City Engineer.

Between 1909 and 1914 Memphis did about as much paving, sewerage and drainage work as any city in the country of its size. Every maintenance bond has expired. We feel, therefore, that we have done all that can be expected if we successfully maintain such improvement as we have.

Memphis has voted $500,000 bonds for the construction of a river terminal, and it is not unlikely that this much-needed project will be undertaken within a comparatively short time.

Our engineering staff is now quite small. We have enough work planned ahead to keep us busy for some time should prices return to normal.

Nashville, Tenn.

Following Engineering News-Record War Program Editorial. Expects To Be Ready for Public Works Expansion After War—From William W. Southgate, City Engineer.

The 1918 policy and program of Nashville has conformed in a general way to the suggestions and spirit of the "War Program" editorial in *Engineering News-Record* of Jan. 3, 1918. There has been a pruning down of public undertakings and a limitation thereof to things that are considered absolute necessities. Highway work has been confined strictly to the maintenance of roadways in proper condition for traffic and no new street grading or paving has been undertaken.

During 1917 legislative authority had been obtained for the issuance of $1,000,000 bonds for the expansion of the city's sewerage system, and surveys, plans and estimates had been made for undertaking the work on a very large scale. Early this year the commissioners decided to market less than a third of the sewer bonds on account of the war conditions. The $300,000 of sewer bonds were sold at a satisfactory price last February and we fully expected to proceed at once with our sewer work. But just then the United States Government decided upon the location and construction of one of the largest war munitions plants in the world about ten miles above the city, on the Cumberland River, and instantly an abnormal demand was created for labor. The price of labor considerably more than doubled. The commissioner of streets and sewers wisely concluded not to compete with the Government powder plant for labor and deferred undertaking the sewer construction work on a large scale until after the Government's requirements at the powder plant have been accomplished. As a result, the city is only undertaking such sewer extensions as are absolute necessities. In the same spirit, water-works undertakings are limited strictly to maintenance service now existing.

The work of the Engineering Department has been greatly curtailed. Our field force has been cut down to one corps and the office force reduced strictly to necessities. The field corps work is largely devoted to surveys for future street and sewer extensions and the office force is engaged in catching and platting field notes. When the tension of war conditions is relaxed the Engineering Department expects to be ready for such expansion of public works as the city may require.

Akron, Ohio

Has Municipal Retrenchment Program. Plans for Post-War Improvements Being Made—From H. S. Morse, Director Public Service.

Akron has experienced an extremely rapid growth. With the possible exception of Detroit, it is the fastest growing city in the United States. Consequently, the need of extensive public improvements of all sorts is very great. Under such conditions it means more for Akron to curtail its program of public improvements than is the case in most cities. Nevertheless, Akron is following a municipal war program. Briefly, this program is retrenchment in permanent improvements coupled with preparation of comprehensive plans for future work.

The City Council has passed a resolution that with the exception of two thoroughfares, which are in extremely bad condition, no new street pavements will be laid this year. Meanwhile we are establishing grades on all new streets, adopting standards and bringing our records up to date. We are also expanding our work on street repair in order to meet the lack of new construction on unimproved streets, of which Akron has many miles. We are cutting the gutters and crowning with graders pulled by tractors, following this work with a covering of cinders. As a makeshift, this method produces a very good street. This program, in addition to meeting war conditions, possesses this advantage—the development of our water and sewerage systems and other underground construction will precede the laying of pavements.

Separation of street and railroad grades has been postponed. The development of parks is also considered unessential just now, although our park system is altogether inadequate. Recreation facilities in existing parks and on private property are being increased.

Our water-works program alone is proceeding, in so far as possible, regardless of the war. This is necessary because not only our people but our industries are dependent upon the water-supply. We are now extending the water-works system under a bond issue of $1,000,000, authorized last year, and are about to ask the people in the August election for an additional bond issue of $2,000,000.

Our sewerage system is also altogether inadequate. Under a $50,000 bond issue voted by the City Council last February, we are making a survey and record plans of existing sewers as the first step in the preparation of a comprehensive plan of sewerage.

We are having difficulty in maintaining our engineering staff because of a lack of men due to the draft and enlistment, but more particularly because of offers of higher salaries than we are able to pay—an experience not confined to Akron.

Cleveland, Ohio

New Projects Discouraged or Prohibited. Planning for Future—From Robert Hoffmann, City Engineer.

By reason of financial limitations the carrying out of new projects by Cleveland has either been discouraged or prohibited. Most of the work still in progress is such as had its financial provisions made before we entered the war. New projects will be restricted to those absolutely essential.

The engineering staff has been subjected to numerous changes and at present is somewhat smaller than normally. It is the intention to continue engineering studies in connection with proposed improvements, even though construction work does not seem immediately possible. There is ample opportunity for such work, and it seems quite consistent and proper that it should be done. Our city plan commission is busily studying local problems, and a rapid transit commission is working on a subway plan. Although construction work cannot proceed in connection with either of these projects, yet planning can well be done now, so when the time arrives to proceed with the work, the usual time spent in preparation can be saved.

Toledo, Ohio

Will Be Ready to Employ 15,000 Returned Soldiers After War. Has 13 Engineers in Service—From H. C. McClure, Commissioner of Engineering and Construction.

Toledo's Department of Public Service has prepared plans for some 65 paving jobs at an approximate cost of $1,500,000; for local sewers at an estimated cost of $200,000; and for an intercepting sewer system at an approximate cost of $3,000,000. Special items, such as street intersections and grade separations, amount to $1,500,000. The same general situation exists in the park department as regards park and boulevard improvements. The safety department should also build at least three new safety buildings. On account of the present national situation, we do not contemplate awarding contracts for any of these improvements with the possible exception of local sewers. The street department must assume the additional burden of keeping streets in repair which would ordinarily be properly paved.

The only issue on which we have asked the approval of the Federal Reserve Board covers sidewalks, local sewers and some local health measures.

From the present indications, if the war extends over a period of two or three years, Toledo will have at least $10,000,000 worth of work ready to proceed with immediately. We feel that this will give an opportunity for the ready employment of the 15,000 men who have already gone from this city, which number, of course, will be materially increased before the end of the war period.

We have lost from this department, mostly by enlistment, 13 men. These include one major, four captains, four lieutenants and four privates. We have not attempted to replace the men except in one or two very necessary instances. They have been given extended leaves of absence and will be reinstated at the end of the war, if it is their desire to come back. Our present force is operating at just about half its regular quota, getting up records, maps and data which have been neglected in times past.

Youngstown, Ohio

All Expensive and Unnecessary Improvements Suspended. Chief Engineer Gives Part Time to War Housing—From F. M. Lillie, Chief Engineer.

Youngstown has suspended all of the more expensive improvements, and those not necessary to the health of the city.

Three assistant engineers and three inspectors have resigned, leaving three assistant engineers and nine inspectors. On account of slack work it will not be necessary to fill the staff at this time. The chief engineer is using a part of his time with the Government, planning housing.

The records have all been brought pretty well up to date.

Chicago, Ill.

Water-Works and Bridge Programs Worked Out Before War. City Council Refuses to Raise Engineering Salaries Fixed 20 Years Ago—From John Ericson, City Engineer.

Water-works and city bridge construction programs in the City of Chicago cannot in any way be altered as a result of war, except, of course, to curtail progress on account of the lack of materials and labor. What I mean to say is that we have sufficient definite programs, planned ahead previous to our entering into the war, to keep us busy for a good many years to come if the necessary finances are forthcoming. We are earnestly in hope that some remedial legislation will be granted, as a result of which the City of Chicago can increase its income and carry on some of the urgently needed improvements, both in our bridge building program and in the extension of the water-works system—which are the only public improvements under the city engineer.

Our engineering staff is greatly depleted, we having lost many of our former employees either through entering the Army or Navy or accepting more lucrative positions elsewhere. The city council, notwithstanding repeated requests, has not as yet seen fit to increase the salaries of engineers, which have been stationary for about twenty years, with the result that there is no particular inducement for any engineer of any capabilities at the present time to enter the city's service.

Davenport, Iowa

Conditions Normal But Plans for Future Work Deferred—From Roscoe Sawistowsky, City Engineer.

Construction work in Davenport is of the same amount as usual and promises to keep up to normal for the year. We also have prepared preliminary plans for improvements totaling about $500,000, which will not be attempted until the war has ended, because of the desire not to put an expense on property owners for improvements that are not absolutely necessary at the present time. Two of the engineering staff are serving their country. I have had no trouble in keeping the engineering staff at full strength.

Fargo, N. D.

Long-Time Construction Program Checked by War. Has 22 of 23 Engineers in Service—From F. LaF. Anders, City Engineer.

About the beginning of the European war Fargo adopted a progress plan of construction for sewers, water mains and paving, to cover a period of from five to ten years. For about three years we were able to follow the program, but naturally it is now becoming somewhat disjointed and limitations are being placed upon its rate of progress. Work is being limited to present necessities and to the completion of contracts let about a year and a half ago.

In 1917 I employed 23 engineers, of whom 22 are now in the United States service. Most of these men have gone into the engineers and infantry; some into the coast artillery, the signal corps, aviation and balloon sections. The 23rd Engineers took quite a bunch of my men last fall, all of whom are now serving in France. I want to say, however, in spite of their anxiety to get to the front, they took into consideration the war conditions and did all the work that it was possible for them to do, covering all the contracts that were to be completed this year. The present staff will be used to bring our records up to date and for other work that is at times neglected for various reasons.

St. Joseph, Mo.

Construction Cut to Minimum. Planning to Bring Records to Date and Make Resurvey of City—From H. D. Judson, City Engineer.

St. Joseph has no definite war program. We have discontinued all construction work except that which it is thought impossible to let go indefinitely. We are doing far more repair work than usual with the view to making the pavements or other much-needed improvements serve until after the war. This is particularly the case with many miles of macadam streets which, a year ago, were so badly in need of repairs as to be on the waiting list for new pavements. We repaired and oiled about 250,000 sq.yd. of macadam pavement last year and expect to continue the good work this season.

It is the policy of this department to go right ahead with all street grading work which can be done and to construct sidewalks on these newly graded streets; but the paving on streets for the most part will be deferred until after the war.

Owing to the large curtailment in construction work, our engineering force has been reduced about 30%. The salaries of the employees remaining in the department have been slightly increased.

We plan to bring up to date all records which have been neglected, and to work up some new and long-needed records. We have also arranged to take advantage of the lull in construction work to make a complete resurvey of the city, which we do not expect to complete in less than three years.

Houston, Tex.

Has General War Program. Extending Services to Government—From E. E. Sands, City Engineer.

Houston's municipal economies, designed to contribute to the utmost in helping win the war, may be divided into two parts: (1) Activities which directly assist the Government; (2) Curtailments of municipal activities, for the purpose of indirectly assisting in winning the war, in the following manner, by (a) reducing the cost of municipal activities to the tax payers, in order that they may be in better condition to aid the Government financially; (b) reducing the consumption of labor and material so that such labor and material will be available for governmental work.

Regarding direct coöperation with the Government, the City of Houston tendered its entire engineering organization to the Government for use in the construction of Camp Logan and Ellington Field, both of which are located near Houston. The city has put in at its own expense an auxiliary water-supply for the purpose of supplying Camp Logan with water. It has tendered the use of one of its activated-sludge sewage disposal plants to the Government, thus eliminating the necessity of Camp Logan installing its own plant. The city also built certain roads and pavements especially for the benefit of the military camps near Houston, and has turned over to the Government, for its use, the municipal warehouse with an area of 200,000 sq.ft., and Wharf No. 4, with a frontage of 777 ft. and an area of 68,000 sq.ft. Both these latter facilities are located at the terminal of the Houston Ship Channel. For these various services, the city is to receive a nominal sum from the Government, in every case the amount received being considerably less than the amount that individuals or industries would be charged for the services rendered.

As to the second proposition, namely, the curtailment of municipal expenses to reduce the consumption of labor and material, the city has curtailed every construction activity that it was possible to curtail. We have delayed, until after the war, any additional wharf construction. Street paving has been reduced to the very lowest minimum, and at the present time it is practically at a standstill. It is expected that maintenance work will be the only line of paving activities carried on by the city during the remainder of the war, and that no new projects will be undertaken. Extensions of sanitary and storm sewers have been indefinitely postponed, except in certain small areas where the expenditure has been recommended by the United States Public Health Service. Sidewalks in Houston are built by individuals and not by the municipality. The city is requiring only a very small amount of such work to be done.

Spokane, Wash.

Using Local Materials. Engineering Force Monumenting City—From Alfred D. Butler, City Engineer.

The City Council of Spokane has made it a policy to postpone all public improvement work that is not deemed absolutely necessary; and where such improvement work is felt to be necessary, local materials are specified, thus relieving the necessity for shipping in material by rail.

Where pavement is contemplated, we have been laying one-course concrete to a great extent. But in a majority of cases, instead of paving the street, it is planned that the city shall gravel these streets and thus put them in passable condition until after the war.

The work in our department has been materially decreased by reason of the fact that so much of the improvement work has been eliminated. We have thrown our organization into the monumenting of certain sections of the city where property lines are becoming harder to find year after year.

Only one member of our organization has gone into the Government service, and we have distributed his work among the other members of the department.

Alameda, Calif.

Postponed All Construction Projects Except Belt Line to Serve Shipyards—From B. Hamilton, City Engineer.

Alameda has not done anything definite in the way of a municipal war program but, with one exception, it has postponed all new projects for the period of the war and reduced its activities to those of necessary maintenance. The exception is the installation of a mile and a quarter belt line to serve shipyards handling Government contracts.

The labor question gives us more or less trouble due to the fact that the men can get much better employment in the shipyards and ironworks hereabout.

Los Angeles, Calif.

Thorough Study of Proposed Improvements Being Made. Force Reduced by Half. Bringing Records to Date—From A. C. Hansen, City Engineer.

Los Angeles is making a thorough study of its proposed improvements, and is holding up all work that

is not absolutely necessary at this time. An effort is being made to keep the maintenance work nearly up to the standard of the past year.

Office forces are being reduced nearly one-half from what they were a year ago. All spare time of engineering employees is utilized in bringing records up to date and making precise surveys, district maps, etc.

Like all other cities of the country, San Francisco has had to adjust its construction program to the needs of the times. All new enterprises involving capital expenditure have been postponed and all construction work, such as beach protection, large arterial sewers, and other projects which can be delayed without impairing the nation's necessities, have been discontinued. The engineering department has been automatically adjusted to national conditions. About 28 members of my staff have voluntarily joined the service in the Army and Navy. About a dozen others have entered the employment of shipbuilding and other industrial activities, so that the readjustment of staff will enable us to handle comfortably the limited amount of work now being done.

For the past five years the city has had an epoch of great engineering activities. Over $20,000,000 have been spent, through this department alone, on municipal railways, sewers, high-pressure fire protection, boulevards, and other like work. Many of the records of those activities have not yet been worked out into final shape, but such is now being done with the employees who remain in the city's service.

Our largest and most important project is the Hetch-Hetchy water-supply, which has been slowed down due to the difficulty of selling bonds, but as this project will bring into use about 50,000 hydro-electric horsepower, it is hoped the national authorities will aid us in speeding up this unit of the work, which will take about $12,000,000 to complete. As there is an annual demand for about 60,000 or 70,000 hp. in northern California such a program will conform with the nation's requirements, as it is a criminal waste of natural resources to use oil and coal when the streams in the mountains are flowing wastefully to the sea, without that power being put to a useful purpose.

The spirit of this city is that everything must be done to win the war and all other activities must be subordinated to this purpose. Protection of health and life, industrial activities and some municipal work are indispensable. Our policy is to put the nation's needs first and everything else in a secondary position.

Salt Lake City, Utah

War Economy Practised. Bringing Records to Date. Making City Planning Survey—From Sylvester Q. Cannon, City Engineer.

Salt Lake City has done nothing directly in the way of laying out a definite plan covering a period from three to five years looking toward the winning of the war.

On account of the war, and also because of prohibition going into effect in this state, with a consequent decrease in licenses and revenues generally, the city has found it necessary to reduce its improvements to a minimum in order to avoid the necessity of increasing taxation, or the issuance of bonds.

Prior to or shortly after the entrance of the United States into the war, this department had prepared preliminary plans and estimates for quite extensive improvements in the city covering paving, curbing and guttering, water mains and water-supply improvements and sewerage, as well as park and other improvements, so that we are forehanded in the matter of preparation for such improvements when the proper time arrives. The city government is, however, committed to the policy of strict economy and the reduction of expenditures in every possible way during the period of the war.

The force connected with this department has been very greatly reduced. At the present time the number of employees is less than half that prior to the war. In order to effect additional economy the undersigned was also appointed superintendent of water-works recently. Besides attending to the engineering and inspection work on the few improvements now being undertaken and performing the necessary maintenance work of the department, our force is engaged in making all of our records complete and bringing everything connected with the department up to date.

The city commission has recently undertaken a survey of the city for the purpose of preparing a city plan which can be carried out as conditions will warrant. This work is under the direction of the city planning commission, consisting of a body of six citizens with whom are associated the commissioner of water-supply and water-works, who acts as chairman, and the city engineer. This commission has secured the services of George E. Kessler, of St. Louis and Kansas City, for the purpose of preparing a city plan.

Patriotic Hogs Help in War Time By Eating Camp Garbage

At the entrance of the United States into the war *Engineering News-Record* printed an editorial entitled "The Hog Volunteers to Utilize Municipal Food Wastes" (Apr. 26, 1917, p. 217). Since then the practice of feeding garbage to hogs has been extended to many additional cities and has become quite general among contractors who are disposing of the garbage from army camps. The accompanying view shows the patriotic lines in which the hogs at one of the military camps grouped themselves one day when disposing of the camp garbage. The original photograph was taken by J. L. Snypp of Henry Knight & Son, Louisville, Ky., contractor for garbage disposal at a number of cantonments.

HOW PATRIOTIC HOGS ARRANGED THEMSELVES

Rapidly Growing Ship Production Speeded by the Emergency Fleet Corporation

Shipbuilding Program and Launchings—Expediting the Steel Supply—District Officer with Technical Staff Supervises Yard Work—Central Office Studies Maximum Yard Capacities Far in Advance

RAPID increase of ship production is being recorded. In the months of May and June American shipyards equalled and surpassed the greatest prewar ship construction of any country in the world, and the building curve, in Fig. 1, continues to slope sharply upward. The curve of hulls launched and vessels completed ready for sea service, in Fig. 2, is so far exceeded by the curve of new keel laying that we are likely to see, in another two or three months, a ship output of vastly increased magnitude.

That an enormous shipbuilding program has been built up is exhibited statistically by the figures of the accompanying table. In carrying it out, the vital consideration is rapid construction, represented in tons turned out per month. The significance of rapid-quantity production will be emphasized and symbolized on the Fourth of July by the launching of possibly 85 to 90 hulls at various shipyards throughout the country, representing a total tonnage of nearly a half million—far exceeding the launchings of any prior month. American ship construction thus will enter a radically new phase with the second half of the year.

More than 13,000,000 tons of carrying capacity have been contracted for or requisitioned during construction. While only a small part of this tonnage has yet been completed, the entire quantity is to be delivered within the next eighteen months, according to the program. In performing this work the producing facilities of the shipyards and their supply sources will be fully taxed. On the Emergency Fleet Corporation rests the duty of developing maximum output, by speeding up the shipyard work and by coördinating material supply with shipyard needs.

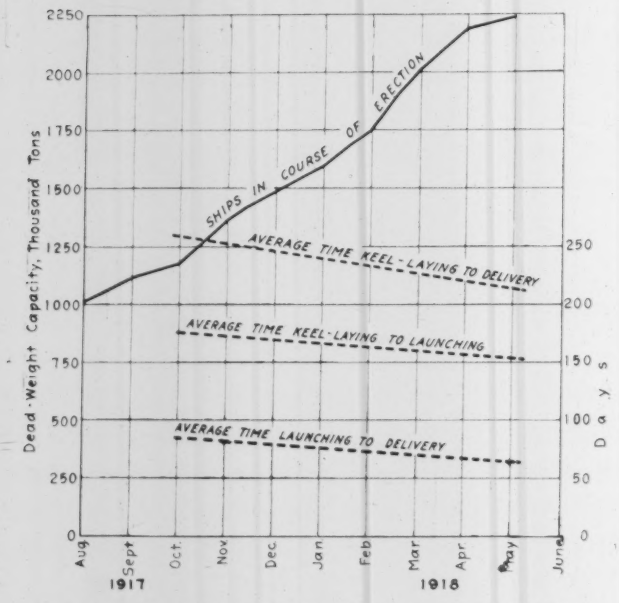


FIG. 1. SPEED-UP IN QUANTITY AND EFFICIENCY OF SHIPBUILDING SHOWN IN CURVES FOR STEEL SHIPS

TABLE I. THE SHIPBUILDING PROGRAM AND PERFORMANCE TO DATE

	Contracted and Requisitioned		Launched		Completed		Under Construction*	
	No.	Tons	No.	Tons	No.	Tons	No.	Tons
Steel (Req.)	404	2,796,798	222	1,396,207	164	1,079,032	103	717,611
Steel	1,255	8,248,230	38	265,950	15	105,750	190	1,242,600
Wood	480	1,645,650	73	260,200	1	3,500	268	904,750
Composite	32	116,000	6	23,000	...	.....	25	89,500
Concrete	42	298,500	00	.....	...	.....	1	3,500
Total	2,213	13,105,178	339	1,945,357	180	1,188,282	587	2,957,961

* These figures include ships actually on the ways. Data as of June 15th, 1918

PRESENT RATE OF CONSTRUCTION

Steel diverted to ship work	200,000 tons per month
Ship tonnage corresponding	600,000 tons per month
Number of ships, about	50 per month

SPEED-UP IN SHIP WORK SHOWN BY RIVET-DRIVING FIGURES

Rivets driven per day on all Emergency Fleet Corpn. Steel ship work.

April (4 weeks)	642,351
May (4 weeks)	734,726

TABLE II. STATUS OF SHIPYARD PLANTS, JUNE 1, 1918

Dist.	No. Yds.	For Steel	For Wood	For Comp.	For Conc.	Com-plete	Ways Total	E.F.C.	Completed* For Steel	Completed* For Others
1	12	4	8	0	0	9	68	50	15	35
2	17	9	8	0	0	9	100	97	60	33
3	13	7	6	0	0	8	59	51	24	17
4	12	3	9	0	0	9	50	48	15	27
5	12	4	6	2	0	4	39	39	2	29
6	10	0	10	0	0	10	53	48	0	48
7	18	11	7	0	0	15	82	68	37	25
8	24	10	14	0	0	22	113	111	42	64
9	16	15	1	0	0	12	71	72	67	1
10	6	6	0	0	0	5	56	35	32	0
11	12	0	11	1	0	12	53	53	0	53
Fabricating	3	3	0	0	0	0	68	68	33	0
Concrete plants	4	0	0	0	4	0	6	6	0	11
Total H.	159	72	80	3	4	115	819	750	327	333

* New ways completed, excluding naval and private, 383.

Present production figures, as given graphically in the curves of Fig. 2, represent only an early stage in the drive for ships. During May and June launchings averaged about 70 ships monthly, with a tonnage of 350,000. In the same period, however, 50,000 tons of steel were going forward from mills to shipyards each week. This rate of supply means, in the ratio of three tons of shipping capacity per ton of steel, that a monthly launching rate of 600,000 tons will be attained soon. In the record year of American shipbuilding, 1901, vessels of 402,336 dead-weight tons were launched. A greater tonnage wil go into the water on the single day of July 4.

THE SHIPBUILDING PROGRAM—STEEL SHIPS FAR IN THE LEAD

In May, 1918, 39 steel vessels of 228,750 tons, and 32 wooden vessels of 115,700 tons, a total of 344,450 tons dead-weight capacity, were launched; the tonnage of ships completed and delivered to the Government was 263,571. The total of completions since Jan. 1 was thus brought up to more than 800,000 (the figures for the five months are 88,507, 123,625, 172,611, 160,286, 263,571). In the first two weeks of June 89,162 tons were delivered complete and by the first of July the 1918 tonnage completed may reach or exceed 1,000,000 tons.

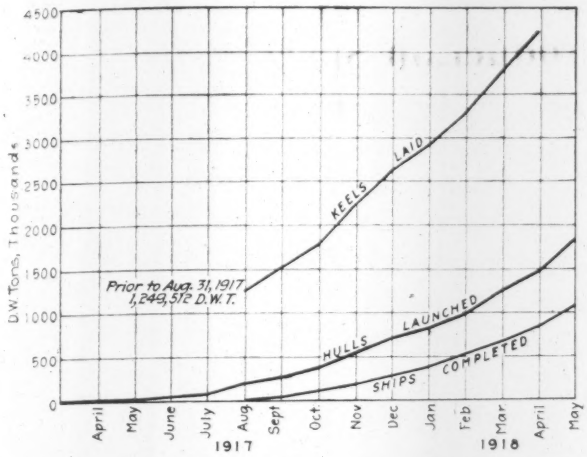


FIG. 2. INCREASINGLY RAPID PROGRESS IN CARRYING OUT THE SHIP PROGRAM

Figures briefly summarizing the shipbuilding program are brought together in the accompanying table. In the total of 2213 ships, of 13,105,158 tons capacity, under contract or requisitioned on the ways, steel ships constitute by far the largest element—11,045,028 tons. Deducting from the steel ship tonnage about 25% representing requisitioned hulls, leaves 8,250,000 tons of contract ships.

Fabricated ships make up 4,647,000 tons of the total of steel ship construction. These vessels are assembled of parts fabricated in bridge shops. The other 6,400,000 tons represent vessels built in the shipyards without the coöperation of bridge shops. The type of vessel in which civil engineers and the civil engineering industry are essential contributing factors will thus play an important part in ship production during the coming months. So far only five or six vessels of the type have been launched, but when the tonnage output of 600,000 per month, already mentioned, is reached, with 100 or more launchings per month, fully half of these will be fabricated ships.

Expansion in Yard and Shipway Capacity

Shipyards have been increased in number and in way capacity to carry out the program. Since the war began 53 new yards have been established, and the number of ways has been more than doubled; 383 new ways added to those formerly existing gives a present number of 660. Construction now in progress will increase the number of shipways to 819, nearly all of which, 750, will be under the direction of the Emergency Fleet Corporation.

How the shipyards stood on June 1 of this year is set forth in Table II. The figures clearly show that the country's shipbuilding machine is not far from the stage of full capacity operation.

Speeding Steel Ship Construction

Since steel ships make up the bulk of the building program, its development is closely tied up with the steel supply. To this extent it is dependent upon the director of steel supply of the War Industries Board, at Washington, who administers the country's steel resources. Through his office the steel needed for ships and that needed for other war purposes is coördinated with furnace and mill production; quantities are allotted to the different industries in accordance with their importance. In the expansion of yard facilities more and more steel has been given to shipbuilding, until now a tonnage exceeding 200,000 per month is being devoted to this purpose.

Two-thirds of the steel needed for the hull of a ship is plates, while about one-third is rolled shapes. The steel producing capacity of the United States, over 37,000,000 tons per year, is ample, in the opinion of steel men as well as of the Fleet Corporation officials. The country's plate mill capacity, however, totals only about 4,900,000 tons per year, and not much over half of this is ship plates. Official statements indicate that nearly all available ship steel is being devoted to the needs of the yards. During recent weeks about 52% of the plate capacity has been turned to shipbuilding. During the rest of 1918 the flow of steel to the shipyards is likely to be increased, but not greatly.

To secure every ton of available steel, the Emergency Fleet Corporation is steadily at work determining the full requirements of the various shipyards, and each month it makes claim for the amount so determined, upon the Director of Steel Supply. By this process it exerts pressure constantly to supply the shipbuilding industry with material as plentifully as the country's resources make possible. The tonnage requirements to meet the contract program have been compiled for months ahead. The present trend of the draft upon the steel mills is indicated by the curve in the diagram, Fig. 3, averaged from the figures of ship steel deliveries of the present and the past few months. As indicated by figures recently made public by Edward N. Hurley,

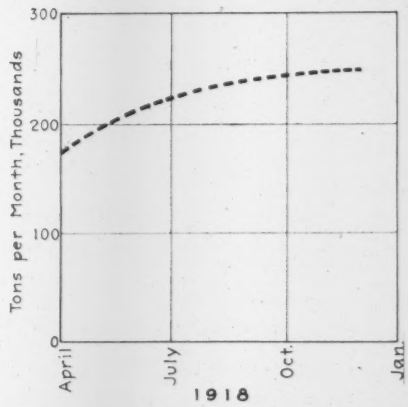


FIG. 3. STEEL FURNISHED FOR SHIPS IS INCREASING

Chairman of the Shipping Board, we shall soon have a shipbuilding capacity considerably in excess of the supply indicated by the curve in Fig. 3. Chairman Hurley's estimate of more than 13,000,000 dead-weight tons of shipping that can be built in one year means 4,250,000 tons of steel furnished in a year, or 350,000 tons per month.

Supply Division Handles Steel Orders

Two departments of the Emergency Fleet Corporation work on the problem of steel supply: the steel ship division and the supply division—a consolidation of the

production division and the purchasing division. The supply division handles directly all demands for ship steel, and, after orders are allocated by the Director of Steel Supply, it also handles the orders. Subsequently it follows up steel deliveries and expedites them wherever shipyards needs make such action necessary.

More than a month in advance, every steel shipyard sends to the supply division a detailed list of its steel requirements for a month. These lists represent the steel which must be delivered during that month, either to the shipyard shop or to bridge shops where parts are to be fabricated; thus they antedate by possibly six or eight months the completion of the ships, depending on the kind of material involved. The supply division has a double check of these lists, first, through comparison with the results of advance calculations of steel needed to meet the contract program (a forecast curve on a diagram like that of Fig. 3), modified as necessary where a yard is ahead of its program or the contrary; second, by checking against yard progress reports records of steel consumption compiled by the corporation's resident agents. These records center in the steel ship division. By using these two checks, the supply division when it presents its list to the Director of Steel Supply at Washington is enabled to give definite assurance that the listed material is indispensably necessary if the shipyard work is not to be slowed up.

At the present time the yard requirements have been so adjusted to the available steel producing capacity

FIG. 4. DISTRICT SYSTEM FOR EXPEDITING MATERIALS AND DIRECTING SHIPYARD WORK

(Numbered black areas are Ship Construction districts: Lettered areas are Supply districts)

that the shipyards' demands are being met by the steel authorities approximately in full.

Following up steel deliveries and seeing that they correspond to the orders based on the allocations of the Director of Steel Supply form one of the most important activities of the production division. This work is done through expediters, men in the field who keep track of the material as it goes through the mills and when necessary issue instructions to push ahead this or that kind of material, to meet the schedule. These expediters form part of a complex field organization of the supply division, handling the pushing or expediting of all kinds of equipment and supplies for ships. An organization of district expediting offices covering the entire country is maintained by the division; their territories are arranged as indicated in the map, Fig. 4.

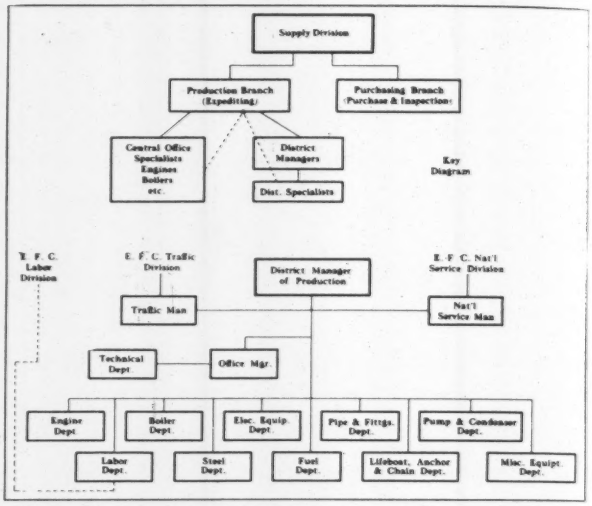


FIG. 5. FIELD EXPEDITING ORGANIZATION OF THE SUPPLY DIVISION

These offices deal with boilers, engines, chain, lifeboats, tableware, compasses and materials of many other kinds. The organization of a typical inspection district is built up on the scheme outlined in Fig. 5. The key diagram in the figure indicates by the dotted line a correlation between the field expediting done through the district offices of the production branch, and the field quality inspection done by representatives of the purchasing branch. In the main diagram the district manager of production directs the district heads for each separate class or group of supplies and is in correlated contact with the representatives of the Fleet Corporation's traffic department.

The functions of the separate bureaus under the district manager are explained by the names given on the diagrams, in general. The technical department gathers information of the workings of all parts of the district office, and keeps such records of them that the information can be transmitted to the central office of the supply division in Philadelphia. The labor investigator reports through the district manager, but is in close touch with the labor department of the Fleet Corporation. The fuel man, by way of the central office, keeps in contact with the national fuel administration at Washington.

The whole organization of the district office is in a sense mirrored at headquarters of the supply division, in that each branch of the field work is represented by a department head in the Philadelphia office.

The head of the engine department or of the steel department maintains constant contact with the district engine representative or steel representative, not by direct correspondence but by reports and correspondence routed through the district manager and the head of the supply division (M. C. Tuttle). The system of centralization of all field activities territorially and centralization of all headquarters activities, while maintaining full subdivisions on technical and functional lines is considered fundamental to the success of the production division.

In view of the great scope of the district activities, success of the field organization has been held to be dependent on the qualifications of the district manager.

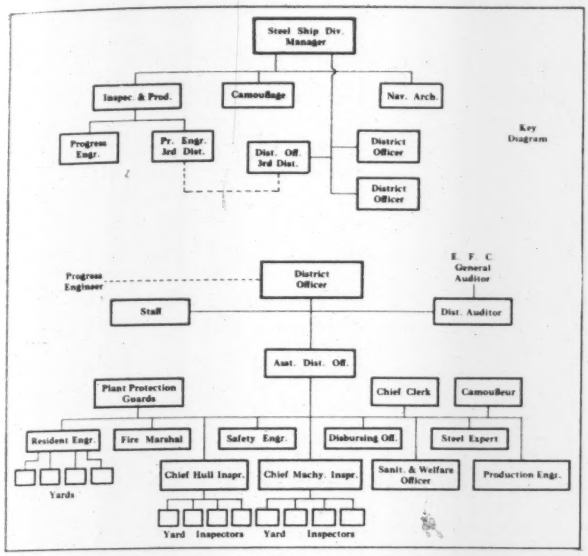


FIG. 6. DISTRICT OFFICE ORGANIZATION, STEEL SHIP DIVISION, EMERGENCY FLEET CORPORATION

The type of man required for this position is defined as follows by an official of the division: "A successful man well and favorably known in the community where his headquarters are located, and either possessing technical training or in his prior experience closely in contact with engineering or technical activities."

Speeding up yard performance is one of the principal functions of an elaborate field organization which the steel ship division of the Emergency Fleet Corporation maintains. The districts of this organization are indicated by black areas in the map, Fig. 4. The district officer with a technical staff, which in an ideal case would be organized according to the diagram, Fig. 6, carries on the field operations. He is able to maintain detailed contact with progress in plant and ship construction at each of the yards in his territory, ranging in number from ten to twenty-four.

Plant construction, proposed improvements, expansion of facilities, inspection of quality of work, fire protection, and in some measure expediting of equipment, are among the functions taken care of by the district offices in addition to the principal one of driving ship construction at maximum speed. A full report on all parts of the inspection and supervision is returned to the central office semi-monthly. Such a report is a thick volume of tabular statistics, comment and recommendations, photographs, curves and the like. To insure its receiving detailed attention in the central office a district organization is maintained there, each district being represented by a progress engineer.

The progress engineer of a given district is the personal agent of that district and is intrusted with the duty of keeping himself informed in detail on all matters in his district, of following through the semi-monthly reports and of carrying forward such matters as require central office attention or action. He is in contact with all correspondence between the districts and the central office, studies the recommendations made by the district officer in his report or directory, and lays them before the executive officials of the steel ship division.

The progress branch of the division, to which these progress engineers belong, is thus the source of initiatory action in a great many matters relating to yard construction and shipbuilding. It does not exercise its functions directly, however, but acts through the executive head of the division.

The steel supply situation of each yard is reported on by the district officer separately from his regular progress report. From the yard statistics he keeps a record of the steel received, fabricated and erected, and the reserve supply. These figures, collected in the central office, are utilized in checking up the requirement list which the supply division lays before the War Industries Board each month. In conjunction with the tables of anticipated steel requirements, prepared months in advance by the steel ship division, and with performance charts of the various yards summarized from the progress reports, and showing at a glance whether any given yard is behind its schedule or ahead, an accurate estimate of the steel needed can be made.

Performance records of the shipyards are compiled by the steel ship division on semi-graphical tabulations, a small piece of one of which is represented in Fig. 7. These sheets are so arranged that two lines are devoted to each ship under construction at a given yard; on another sheet two lines are given to each yard in a given district; on another sheet two lines are given to each district in the country, with a separate section for the country as a whole. On all of these sheets yard performance is represented by the number of rivets driven, summarizing ship erection, and the percentage of equipment installed. In each monthly column are entered two figures for rivets, one representing the number of rivets which at normal performance should be driven during that month, and the right-hand figure representing the summation, to the end of that month, of normal or allotted rivet performance. Just below this is drawn a thin line which from the report of that month represents the percentage of the allotted task

TOTAL PROGRAM—STEEL SHIPS—1918

HULL ERECTION ENTERED TO 5-11, '18
EQUIP. INSTALLATION ENTERED TO 5-15, '18

DISTRICT	D.W.T		JAN		FEB		MAR		APR		MAY		JUNE		JULY	
All Districts		HULL ERECT.	16.827	129.31	19.963	149.28	22.709	171.99	25.381	197.37	25.221	222.59	25.968	248.56	23.144	271.70
530 Ships	3639.74	EQUIP INST.	2.793	10.759	2.937	13.696	3.592	17.288	4.160	21.448	3.948	25.396	4.216	29.612	4.051	33.663
District No. 1		HULL ERECT.	.774	7.076	.925	8.001	1.025	9.026	1.193	10.219	.954	11.173	1.042	12.215	.988	13.203
22 Ships	214.20	EQUIP INST	32	412	69	481	99	580	165	745	146	891	112	1003	106	1109
" No. 2		HULL ERECT.	1091	5.478	1.196	6.674	1.703	8.377	2.162	10.539	2832	13371				
42 Ships	303.90	EQUIP INST.	58	322	96	418	129	547	200	747	216	963	268	1231	293	1524

FIG. 7. PERFORMANCE SHEET OF YARD WORK GIVES ACCURATE SPEED COMPARISON OF YARDS AND DISTRICTS

which was actually performed, 100% being the full width of the monthly column. Below this, again, is drawn a heavy line which begins at the laying of the keel of the ship or at the start of operations of the yard, or, in the case of a district, at some other fixed date, and represents by its length the percentage of total allotted performance to date which the ship, yard or district can show; for this line 100% represents the distance from the start to the end of the monthly column.

The line below represents machinery installation by figures and horizontal lines in just the same way. The rating here is on the basis of percentage of completion, instead of in number of rivets driven.

A general gage of the speed-up attained in steel ship construction is furnished by the figures for rivet driving in April and May, four weeks of each month being counted. The figures are 642,351 and 734,726, respectively, the two figures covering practically the same number of yards and shipways. A gain of 15% is shown, which is a gain in intensity and speed of working, in the opinion of Fleet Corporation men.

Study for Full Utilization of Yard Capacity

Apart from its regular field work, the steel ship division is carrying out a study of yard capacity with respect to all existing shipyards in the country. Its purpose is to determine the output capacity of each yard, as developed to its maximum, with a view to employing the full capacity of every yard up to 1920. Future contracts are allotted in accordance with the findings of this study.

By collating th results of the work of the inspectors on this study with the performance reports of the district officers, and with recommendations for improvements made by them, precise information is being secured to guide expansion of shipyard shop facilities and other steps that may be necessary for speeding shipbuilding to the utmost.

What the fabrication of ship parts outside of the yards may accomplish has in part been indicated, but estimates of total capacity show that the possibilities in this field still make a large reserve available. Estimates based on reliable information and judgment place the fabricating capacity outside of the shipyards—bridge shops, car shops and related establishments, including new developments—at about 200,000 tons of ship parts per month. This total is made up of many items, the capacity of the country's largest fabricating group being put down at about 30,000 tons. The steel demands for the entire fabricated ship program, existing and proposed, amount to 1,500,000 tons, about two-thirds of which approximately must be done during the coming ten months. From the figures applicable to the subject, officials of the Emergency Fleet Corporation have deduced that the fabricating resources are used to the extent of about 50% at present. The remaining 50%, only part of which is occupied by bridge and steel building construction, is available for speeding up the production of fabricated parts if this should prove desirable.

With 45,000 men in the shipyards a year ago and more than half a million in shipyards and contributory trades today (300,000 in the shipyards alone), a steadily increasing shipyard activity was predicted recently by Edward N. Hurley, chairman of the Shipping Board:

"From all present indications it is likely that by 1920 we shall have close to a million men working on American merchant ships and their equipment."

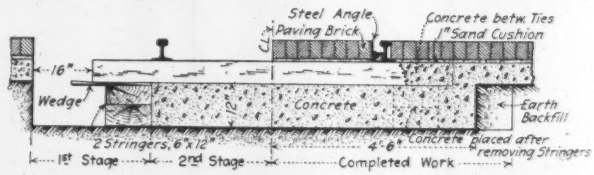
Long before this great army is in service, however, the United States will be producing ships at a greater rate than all the rest of the world combined. The total ship production in 1918, according to Chairman Hurley, will be about 4,000,000 tons in countries outside of the United States, and more than 3,000,000 tons in this country; and, he states, "our tonnage output will continue to increase until before this year closes we will be turning out half a million tons each month.

"In 1919 the average tonnage of steel, wood and concrete ships continuously building on each way should be about 6000 tons. If we are using 751 ways on cargo ships, and can average three ships per way per year, we should turn out in one year 13,518,000 tons, which is more than has been turned out by Great Britain in any five years of her history."

Railway Crossings Have Concrete Base

PAVED street crossings on the Atchison, Topeka & Santa Fe Ry. frequently have the tracks supported on a 12-in. concrete base, and have concrete filled between the ties to carry the paving. Brick is used mainly for the paving, as it more generally conforms to the street construction, but a concrete surface is used in some cases. The general design of the brick-paved crossings is shown in the accompanying drawing.

To reconstruct a crossing on this plan, excavation is first made along and under the ends of the ties to a depth of about 13 in. On each side two timber stringers are placed, just outside the rails, and are wedged up to give the ties a firm bearing. In the middle of the



RAILWAY USES CONCRETE BASE AT STREET CROSSINGS

track excavation is made between and under the ties to a depth of 12 in. This space is filled with concrete, which is packed under the ties and is then allowed to set for two weeks before the load is transferred to it.

The timber stringers are then removed, and concrete is filled under and between the ends of the ties. A small rib or stringer of concrete is laid along the inside of each track rail to carry the steel angle which forms the flangeway guard, this angle being anchored to the concrete. A 1-in. sand cushion is then spread on the concrete base and the brick paving is laid and grouted.

Traffic is maintained without interruption, but all trains are required to slow down in passing over the work. It is stated by C. M. Buck, division engineer at Topeka, Kan., that as the adjacent roadbed has 12 in. or more of stone ballast, the concrete crossing does not make a noticeably hard-riding spot in the track even though trains often pass over outlying streets at a speed of 20 miles per hour.

Industrial Research for War and Reconstruction

Abstracts of Two of the Papers Presented at Meeting of American Society for Testing Materials During Topical Discussion

The topical discussion on coöperation in industrial research at the A. S. T. M. convention last week was introduced by Henry M. Howe, whose paper follows, while the paper by Arthur D. Little, largely reprinted below, also featured the meeting. Dr. John Johnston, Secretary of the National Research Council, outlined recent developments in Great Britain and Dr. Charles L. Reese told of the results attained by the du Pont de Nemours Co., while practical aspects were discussed by Dr. W. D. Bigelow, J. S. Unger and D. A. Abrams. Doctor Johnston brought out the important fact that the cost of industrial research is only a small fraction of fire insurance cost.

Industrial Research for Sharp Answers to Definite Questions

By Henry M. Howe

Chairman, Engineering Division, National Research Council

A VERY great advance towards coöperation in industrial research was made in 1868, when, on the initiative of Sir Lowthian Bell, the Iron and Steel Institute came into being, and replaced the habitual secretiveness of the British iron master with discussion of the principles and practice of his art. Only three years later, in 1871, the American Institute of Mining Engineers was founded under the stimulating leadership of Holley, Drown and Raymond for a like but even broader effort to replace secrecy with discussion.

Another great leader, Judge Gary, took an important step when he started his steel-makers' dinners, and brought those who had been intent chiefly on cutting each others' throats into aiding each other. And now we propose another step, that wherever feasible, the industries shall not only permit such disclosure and discussion of their discoveries as occur at the meeting of technical societies, but shall coöperate in making their discoveries.

Small manufacturing companies so fortunate as to feel that they can trust each other may well look at coöperative research as simply one step in the inevitable enlightenment of human ways. Each step has seemed visionary and Quixotic to those who lack vision, but to the natural leaders it has seemed an obvious extension of the displacement of antagonism by coöperation. The setting up of specifications and standards of reasonableness by this society is one example. Another is the formation of conferences between the selling departments of the competitors in a given industry.

Though the immediate motive for founding an industry is to make money, yet in another sense each exists primarily to serve the public and incidentally to gain for its projectors and managers a just reward for their courage in supplying funds and for their skill and energy in using them, for their product can be sold only as the public profits by buying it. The pecuniary reward should be roughly proportional to the benefit given the public. Clearly John and James can jointly serve the public better, and hence can command greater pay from the public, that is, greater profits, if each serves the public not with his own knowledge alone but with that of his competitor as well.

Four Parts in Research

Every research consists of four tolerably distinct parts: selection, planning, execution and interpretation.

First, out of the immeasurable area of our ignorance we select a certain limited field the exploration of which promises the greatest profit. The problem to be solved should be enunciated with perfect sharpness. The selection of this field demands to-day first a knowledge of the problems which are pressing on our military and other departments, and second, very sound judgment. In other times the pressing needs of the industry dictate the selection. How much good energy has been wasted in the desultory exploration of some little plot which has happened to catch the young investigator's fancy?

Next, the research should be so planned that its results will have the greatest promise of yielding a clear and decisive solution of the problem, a sharp answer to a sharp question. Every kind of test which throws light on service fitness should be used. The consideration that new and unforeseen services are constantly developing argues for widening the range of tests for any given product.

Third, the process itself and these several tests should be made by those thoroughly familiar with them, each detail going to an expert.

Fourth, the results should be interpreted in a strictly philosophical spirit, without bias or reference to preconceived hypotheses. This work of interpretation should indeed be open to all connected with the research. Yet because what is everyone's duty is no one's, certain men should be charged directly with this vital task, knowing well that their inferences are subject to review by all their colleagues and will be accepted only as they are just and reasonable.

Each of these four phases of research needs special qualifications: For selection, prophecy and breadth of view; for planning, imagination and administration; for execution, skill and trustworthiness; for interpretation, philosophy.

Demonstrates Need of Coöperation

This mere recitation of the needs of research is a demonstration of the need of coöperation, for it is only a few of the laboratories of the very great industries that have either the various kinds of men with these various gifts, or the means to experiment on so wide a scale. Scattered through the many institutions of learning and the laboratories of the smaller industrial works there are innumerable investigators, each with certain intellectual gifts, each skilled in certain kinds of tests, but few with broad knowledge of the needs of the Gov-

ernment or of any given industry to guide them in their selection; relatively few with the breadth of view needed for wise planning; very few if indeed any with skill in all the different kinds of tests needed; and relatively few endowed with the philosophical spirit needed for interpretation. Yet these men collectively have enormous potencies for research, if their several gifts and skills can be brought into broad coöperation. How often do we see results reached with extraordinary patience and accuracy not utilized but prostituted to support a preconceived hypothesis which, rightly viewed, they discredit?

It is our defect as a race that this sort of team play comes less naturally to us than isolated individualistic research, in which each man obeys his own impulses, and is a law unto himself. But as with men so with nations, development implies first of all the cure of our inborn defects. That the unmitigatedness of our individualism is a defect we are reminded sharply by the present grave threat of our national enslavement by a people far less intelligent, energetic, and self-controlled than we, but as coherent as we are incoherent, as given to team play, as desirous of support, as we are self-reliant and detached. Distasteful as it is to us to act on our motto of "United we stand, divided we fall," if we are to survive, our strong units must learn to cohere.

Experience with coöperative research has proved abundantly that, wisely directed, it may stimulate instead of lessen individual initiative, which is of the first importance.

One of the aims of the National Research Council is to induce the coöperative spirit wherever possible in industrial research, and research for the immediate benefit of the Government. The Engineering Division of the Council expects to devote part of its energies to this work, and here it counts confidently on your support.

Organization of Industrial Research

THE war, which has changed everything, has given a new aspect to research, said Arthur D. Little, president, Arthur D. Little, Inc., Cambridge, Mass. Hereafter the nation which would live must know.

Through the wreck and peril of other peoples, Americans have learned with them that research has something more to offer than intellectural satisfaction or material prosperity. It has become a destructive as well as a creative agency and in its sinister phase the only weapon with which it may be fought is more research. The organization and intensive prosecution of research has thus become a fundamental and patriotic duty which can neither be ignored nor set aside without imperilling our national existence.

In considering any plan for the organization of research, one is immediately confronted by the difficulty that science in its highest expression is essentially individualistic and democratic. It resents autocratic control, languishes and becomes sterile under minute oversight and direction from outside. The great advances in human knowledge have almost invariably been due to individual effort set in motion by the scientific imagination and sustained by a consuming desire to ascertain the truth. Pasteur, Curie and Rutherford were not dependent on organization for their results. They worked to the best advantage in proportion as they were free to follow the vision which moved before them. No amount of organization can make a Faraday. It may, perhaps, discover one and is then privileged to provide encouragement, working facilities, and recognition. With these assured it is the part of wisdom to leave him as much alone as possible.

Provide for Exceptional Man

Any really effective plan of research organization must provide for the exceptional man, the man whose angles have not been ground down, who is sometimes not comfortable to rub against, but who has the spark of genius. He is usually a man who hates rules and systems, regular hours, time slips and all the paraphernalia of organization. Organization can help him none the less by relieving him of burdens, making him master of his own time, furnishing equipment, providing organized and immediately available library facilities and by directing his attention to specific problems.

While the superlative work in science, like the superlative work in art, must always be an expression of the genius of the individual and quite beyond the power of organization to ensure, there remains a vast deal of what may be called the secondary work of rounding out the great discoveries and especially of giving them an industrial application which may be rendered most effective only through proper organization. The nimbus which, just at this time, surrounds the word "research" should not blind us to the fact that research involves a great deal of hack work, work for good honest plodders who accumulate the data which permits or confirms the generalization or which is required to give it practical effect.

Aims of Research Organization

Broadly stated, the aims of research organization should be:

1. To find, develop and train men.
2. To create such a background in the public mind as shall ensure support for research and the industrial utilization of research results.
3. To secure coöperation between different branches of science, as for example between chemists and mathematicians. The fortuitous combination of the mathematical mind with the viewpoint of the chemist in Willard Gibbs laid the basis for physical chemistry. But such a combination in a single individual is very rare.
4. To avoid repetition and duplication of effort, first by rendering present knowledge readily available to research workers, second by applying clearing house methods to research projects.
5. To stimulate research by emphasizing the importance of specific problems, making special grants, rendering material and facilities as generally available as possible.
6. To furnish a sort of general staff for research which shall work out the plan of attack for major problems, assign the several lines to competent workers and coördinate and focus the whole.
7. To bring home to manufacturers the advantages of research with the view of promoting the establishment of private, corporation, and group laboratories.
8. To make and publish a census of available research facilities in men and equipment.

9. To survey the natural resources of the nation and direct research toward their development.

10. To appraise our great industrial wastes and develop plans and methods for turning them to profitable use.

Councils and Committees Not Effective

There is a nearly universal tendency to attempt the accomplishment of these results through the agency of councils and other forms of committee organizations, the members of which are almost without exception unpaid and involved in other activities which have prior claims upon their time. While such systems of organization may be temporarily efficient and even the only ones immediately available in times of sudden crisis, they do not lend themselves effectively to the slow, constructive work of years without which it is impossible to establish research in its proper place in the industrial and other activities of a nation.

There is danger in an organization chart: danger that it be mistaken for an organization.

The work of committees is notoriously cumbersome and slow. The capacity of a committee to achieve results is usually determined by its chairman and is somewhat below his normal working ability as a unit. The reference is of course to executive capacity and ability. In the initial discussion and formulation of plans and policies committees play an essential and most useful part.

As the committee organization is extended to cover the diverging ramifications of a many-phased activity the inherent weakness, for executive purposes, of this form of organization becomes increasingly apparent. More and more power must be developed by the central body to overcome the inertia of the augmented mass. The whole may ultimately break down from its own weight.

Evolve Permanent Organization

It appears then that we may have still to evolve a permanent, coherent and progressively effective form of organization for the promotion and coördination of research. This may perhaps appear in the shape of a great foundation closely affiliated with the government, the universities, the technical societies and the industries, which shall have its broad policies directed by a board, wholly divorced from politics, yet intimately in touch with the trend of science and the needs of industry, and which shall depend for the execution of its plans upon a permanent executive scientific staff.

Any permanent research structure of national dimensions must of course have its foundations in the universities and technical schools. Unfortunately in this time of greatest need these institutions are seriously handicapped by the very generosity of their response to the demands already made upon them. In the scientific departments the instructing staff has been heavily drawn upon for special service and those who remain are carrying a greatly increased burden. Students are distracted by war interests and are constantly being diverted into military activities.

While recognizing the exigencies of the period and applauding the splendid response of American institutions of learning, it may not be ungracious or premature to indicate some of the directions in which these institutions must ultimately move if they are finally to meet the augmenting demands for research and for graduates fitted to cope with industrial research problems.

It is beginning to be recognized that there is no valid distinction between scientific research and industrial research. Both employ the same methods and the same equipment. The demands of either may involve and tax the highest intellectual faculties, and industrial research frequently necessitates that nicety of refinement and subtlety of attack which characterizes the highest scientific effort. There remains only the shifting and uncertain line of demarkation which may indeed be found in motive. In the selection of thesis subjects and minor research problems greater prominence may therefore well be given to those having a direct industrial application.

Industry must, however, continue to look to the higher institutions of learning for the determination of fundamental facts and constants, the development of theory and the establishment of general principles. Any adequate response to this demand requires that professors and assistants should have far more time available for research than is now at their disposal. They must have some substantial measure of relief from routine and administrative detail. They should and undoubtedly will have more direct contact with the industries. As a consequence more and more of them will undoubtedly be drawn into industrial positions. This will mean no ultimate disaster to the cause of scientific education provided university authorities recognize the patent fact that the day has come when much larger salaries must be paid and greater distinction accrue to capable men of science who are to continue as professors.

Broader Culture Needed

The expanding recognition of the part which applied science is destined to play in our national development would seem to ensure an adequate supply of scientific students and especially of candidates for degrees in chemistry and chemical engineering. Let us see to it at the start that they are provided with a broader culture than has heretofore obtained in many places, lest they be incapable as scholars of meeting their great responsibilities. Concurrently we must provide means for correcting the recognized deficiencies in their professional training which have been pointed out times without number in the hundreds of papers on the education of the chemist and chemical engineer which have been published during the last few years. Bacon, for example, reports that 70% of the directors of important industrial laboratories express dissatisfaction with the type of instruction which their assistants have received. They find the graduates coming to them ignorant of chemical literature and how to use it, lacking initiative, perspective and sense of proportion, failing in optimism, without knowledge of the simplest industrial equipment. Some of these deficiencies are obviously due to the drying up of inspiration at its source; to the displacement of the quickening influence of master minds by the cut and dried methods of pedagogy. Others, more easy of correction, result from inadequacies of the curriculum itself.

It was with the hope of remedying some of the more

glaring of these that I made the proposals which led up to the foundation of the school of chemical engineering practice of the Massachusetts Institute of Technology. Recognizing that each process of industrial chemistry may be regarded as nothing more than a coördinated series of unit operations like grinding, roasting, leaching, evaporating, crystallizing and so on, and that knowledge of these unit operations postulates the ability to combine them as required, the school established a number of stations at large industrial plants selected for the variety of unit operations carried out within them. Groups of third-year students passed in turn through each of the stations, studying practice and illustrating theory in the plants themselves. The reaction of the course upon the students went beyond all expectations and it is one of the minor disasters of the war that the school was obliged to suspend by the requisition of its teachers and the diversion of its students into war activities.

Since the frontier of knowledge is the starting point of research, the energy of the explorer must be conserved on his way to the frontier. In no way, therefore, can organized coöperation render more effective service to research than by making readily accessible those vast stores of specialized knowledge which research has already accumulated but which still require to be brought into that systematized and orderly arrangement which characterizes science. The research laboratory should be built around a library. These special libraries should be linked together and closely affiliated with the great libraries of the world. Such admirable journals as *Chemical Abstracts* should be substantially endowed, the publication of monographs encouraged and assisted, while systematic reviews and reports of progress covering limited special fields in science and technology should appear far more frequently. The intensive collection of scientific and technical information throughout the world, its codification and its distribution, might well be made a governmental function to an extent not now approached.

The natural place for industrial research is in the laboratories controlled or supported by individual corporations, or which are otherwise for the time being working in their interest, or else in group laboratories maintained by trade associations for the common benefit of their membership. It can only be established firmly on a basis which recognizes that people are in business to make money and that for the long pull personal interest must be enlisted. Those of us, therefore, who believe that every waste that is prevented or turned to profit, every specification which gives better control of raw material, every problem solved, and every more effective process which is developed makes for better living in the material sense and for cleaner and more wholesome living in the higher sense, can render no more effective service than by aiding the American manufacturer to understand what research is, what it costs, why it pays.

Tests Give New Information on Concrete Behavior

Abstracts of Some of the Papers Presented at the Meetings of the American Society for Testing Materials and American Concrete Institute

Valuable data on concrete strength, wear and manufacture were included in the papers delivered at Atlantic City last week at the meetings of the American Concrete Institute and the American Society for Testing Materials. Of the papers abstracted below that by Captain Edwards on proportioning concrete was a Testing Materials paper, the remainder were presented to the Concrete Institute.

Proportioning Concrete From Surface Areas of Sand

That the strength of cement mortars, and consequently of concretes, is dependent upon the quantity of cement in relation to the surface areas of the aggregates, consistency and physical qualities being equal, is the novel theory advanced by Capt. L. N. Edwards, U. S. E. R., in a paper presented to the joint meeting. Captain Edwards' theory is substantiated by a most elaborate and painstaking series of experiments in which the number of sand grains per gram, over 125,000 in some cases, were actually counted for many samples. The long paper contains much other valuable information on concrete composition, but its main purpose is to demonstrate that as the strength of mortar is primarily dependent upon the character of the bond existing between the individual particles of the sand aggregate, the optimum quantity of the cementing material depends upon the total surface area of the sand. Accordingly a number of sands were counted as to grains, and a mortar made from each on a standard basis of cement to sand area, that area being figured from the number and size of the sand particles. It was found that mortars mixed on this basis, though varying in cement-sand ratio from 1: 1.12 to 1: 3.11, gave compressive strength of surprising equality.

As a practical application of the method Captain Edwards stated that diagrams could readily be made showing the relation between granularmetric analyses of sands and their surface areas. To do this actual counting of particles would have to be made at the beginning. With these diagrams the proper quantity of cement for any given sand could readily be taken off.

In the discussion Prof. D. A. Abrams of the Lewis Institute at Chicago, pointed out the resemblance in ultimate results between Captain Edwards' method and the "fineness modulus" method he has developed. In this method an aggregate is passed through a fixed number of sieves and the percentage passing through each sieve noted. These added up give what is known as the "fineness modulus" and it has been found that strength of concretes, conditions of material, water content and mixing being equal, is dependent upon this modulus. That is, the sum of the aggregate gradations is critical and not the distribution of these grada-

tions along some such line as the Fuller standard curve. The method has been tested in a number of practical applications to field aggregate and is proving successful.

Nathan C. Johnson stated that he considered that in effect the surface area of aggregate was in effect a function of the sieve analysis and that probably Captain Edwards' method could be utilized by an application of the latter instead of requiring the laborious investigation into the actual number of particles. He called attention to the enormous quantity of such particles in a cubic yard of concrete—running up into the two hundred billions—and said that proper mixing of concrete so as to thoroughly scour the sand particles clean and insure their juncture with cement particles would undoubtedly result in a stronger concrete than is now common. A. T. Goldbeck (Office of Public Roads) called attention to the limited application of a similar surface area method used by himself some years ago with success and P. H. Bates (Bureau of Standards) said that the principle was an old one in ceramics.

Long Time Tests on Slag for Concrete Aggregate

TESTS on the value of blast-furnace slag for the coarse aggregate in concrete have been started in Pittsburgh. The tests will extend over a five-year period. P. J. Freeman, of the Pittsburgh Testing Laboratory, describes the first year's results in a paper. The most important feature of the investigation is that slag coming from furnaces many hundreds of miles apart, varying quite widely in chemical analyses, and also varying considerably in weight per cubic foot, do not vary in strength in proportion to either the weight or the percentage of any chemical constituent. Tests will be made at the end of two weeks, one month, three months, six months, one, two, three, four and five years. Investigation is to be made upon the crushing strength of cylinders using air-cooled blast-furnace slag, limestone, granite, trap rock and gravel, and of coarse aggregates in the concrete. A determination of the corrosive tendency of sulphur in slag is to be varied by an investigation at various times of the corrosion of embedded steel, and study is also under way to ascertain the effect of sulphur and other elements on the durability of concrete. The relative strength and durability of concrete made of high-magnesia low-lime slag and low-magnesia high-lime slag are also to be tested.

Aggregate is Critical Element in Fire Resistance of Concrete Columns

TESTS of reinforced-concrete columns under simultaneous load and extreme heat have been made by the United States Bureau of Standards at its Pittsburgh laboratories. In a paper entitled "Fire Tests for Concrete Columns," Walter A. Hull, of the bureau, indicates that the results so far obtained show beyond doubt that the design of a reinforced-concrete column, that is, the amount and disposition of the steel, is not nearly as important a factor in fire resistance as is the nature of the aggregate. Gravel, particularly the Pittsburgh gravel with which the tests were made, proved to be poor material to withstand load tests under high temperature.

Tests were made on 18-in. round and 16-in. square columns. Round columns of 12-in. diameter were made from one aggregate with one type of reinforcement. Two kinds of reinforcement were selected; 2% vertical steel with 1% spiral steel and 2% vertical steel with no spiral steel. For comparison, columns without reinforcement were included. In all columns the steel had a covering of 1½ in. of concrete and in some a plaster coating was applied. This latter served admirably to protect the columns against heat failure. Pittsburgh river gravel, of a maximum 1½-in. diameter, and Pennsylvania high-calcium limestone, ¾-in. diameter, made up the aggregate. Three columns of each kind were made up, giving check fire tests with one cold test.

Tests were made in a special apparatus having a gas-fired furnace capable of raising the temperature to 1200° C., and of giving a load of 600,000 lb. If the column stood the 600,000-lb. load hot it was permitted to cool and transferred to a 10,000,000-lb. machine and tested to destruction.

In the gravel-concrete columns there was a marked tendency in the concrete to break up early in the fire tests and for the resulting slabs to separate and fall off, exposing the load-bearing portion in the column. The steel was exposed. Round columns with vertical reinforcement only suffered much less than those with spiral steel. Square columns vertically reinforced chipped badly. Round columns with no reinforcement showed an intermediate behavior between that of round columns with spiral steel and those without such steel. Strength tests made at the end of the four-hour fire test showed the gravel-concrete columns with spiral reinforcement had retained from less than 15% to approximately 18% of the strength of the column test without exposure to heat. A round column with vertical rods and no hooping retained approximately 30% of its strength; square columns from 15% to 20%, and a plain column approximately 23%. In the limestone column there was no surface cracking during the fire test, either in the square or the round type. The columns after cooling showed a strength approximately 77% of the maximum of the unfired column. Each of the vertically reinforced columns, both round and square without spiral steel, tested while hot at the end of the fire test, showed a maximum strength approximating 50% of that of the unfired column of the same class.

Effect of Time of Mixing on Strength and Wear of Concrete

Results from a series of tests made by Prof. D. A. Abrams (Lewis Institute, Chicago) show that little additional strength can be attained by mixing concrete over 1 min. The tests were most elaborate and involved the investigation of 3800 specimens. Examination was made on the compressive strength of 6 x 12-in. cylinders and on the wear, in a rattler, of specimen cubes, the concrete varying in consistency, cement content and grading of aggregate.

It was found that while there was a certain increase

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Edgar Marburg

1864–1918

EDGAR MARBURG, professor of civil engineering in the University of Pennsylvania, secretary-treasurer of the American Society for Testing Materials, died in Philadelphia, June 27. He suffered a nervous breakdown more than a year ago, from which he never fully recovered, though his condition did not again become serious until two months ago.

Graduated from Rensselaer Polytechnic Institute in 1885 with the degree of civil engineer he served successively in the engineering departments of the Keystone Bridge Co., the Phoenix Bridge Co. and the Edge Moor Iron Co., and the Carnegie Steel Co., his transfer from company to company being due to a determination to secure a well-rounded experience early in life. In 1892 a committee of eminent engineers, having been asked to name a candidate for the headship of the civil engineering department of the University of Pennsylvania, suggested Edgar Marburg, then working in Chicago for the Carnegie Steel Co. He accepted the position, and at once gave evidence of the organizing ability, grasp of situations and ability to get things done for which he later became distinguished. He had already displayed in ample measure his thoroughness and excellent engineering judgment.

Early Days of the A. S. T. M.

In 1898 there was formed at Philadelphia the American Section of the International Association for Testing Materials. Professor Marburg was one of the organizing group; others in the little party were Mansfield Merriman, Henry M. Howe, Charles B, Dudley, W. K. Hatt, Richard Moldenke, R. L. Humphrey, W. R. Webster and Robert W. Lesley. The new section, composed as it was of extremely able men, found much to do but with the hampering condition set by the aims of the parent society made only fair progress. The real accomplishment was the development of a clear conception of what American needs in this field really were.

Early in 1902 Professor Marburg was elected secretary of the section. Within a few months he had written to the executive committee such a clear statement of the purposes which an American testing society should fulfill that the committee decided to recommend the termination of the existence of the section as such, and the establishment of a new society, which would hold membership as a body in the international association and, while affiliated and forming the American branch, be free to set forth its aims independently and adopt its own mode of procedure. The plan for the new society was drawn up on the lines laid down by Professor Marburg—which are those followed today—and the new body formally launched as the American Society for Testing Materials in June, 1902.

Dr. Charles B. Dudley was the president of the society, and Edgar Marburg its secretary-treasurer. A happier combination could not have been found. Both were men of vision, of courage, of sterling standards. They set a high goal, and under Marburg's effective handling an organization quickly rounded into shape and results began to show.

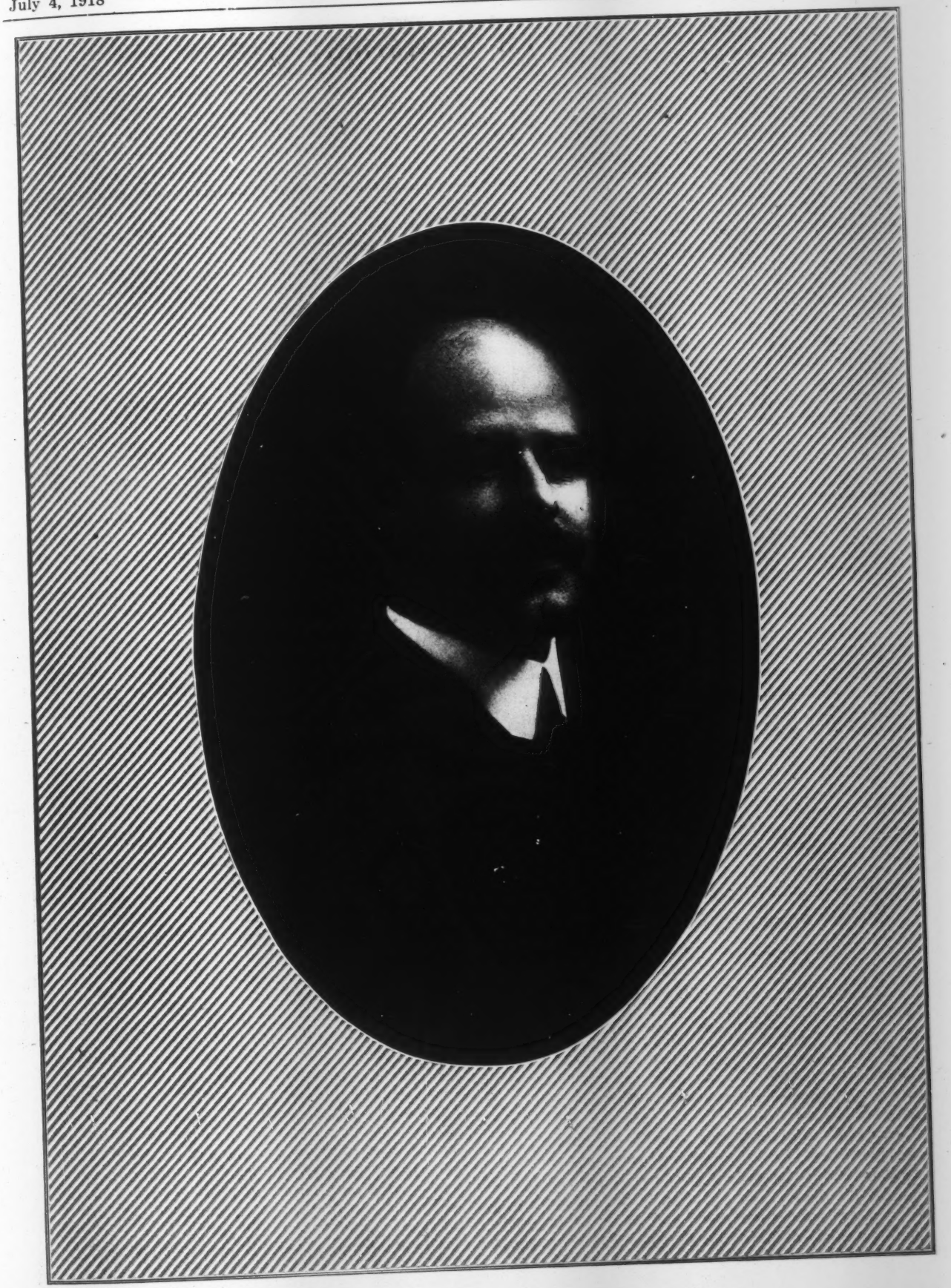
Dudley and Marburg, Marburg and Dudley drew support from quarters hitherto uninterested. The membership increased rapidly, a membership of strong men, capable technically, with a strong realization of the need for results, responding, too, to the high ideals upon which the leaders were constantly placing emphasis. The body as a section of the international had naturally inclined toward the purpose of its parent—the development of the science and methods of testing. The new organization was interested in methods only as a means; its primary object was the development of specifications, and more specifically still the development of specifications which while giving the user materials suited to his needs were at the same time commercially practicable. That this might be accomplished it was laid down as fundamental that both producers and consumers were to be represented on committees, but that the producers should not be in the majority. This procedure marks the society as unique and the great success of the method is full proof of the vitality of the underlying idea.

What the success of the society has been need not be recounted in detail here. Suffice it to say that the membership is now 2261, the annual receipts $39,687, while the standards adopted number 107. One steel producer, to quote only one field, estimates that 75% of all steel bought in this country is purchased either under A. S. T. M. specifications or under slight modifications thereof. While the strongest of the early work was in steel, practically every major engineering material is now covered—the non-ferrous metals, protective coatings, cement, clay products, gypsum, asphalts and tars, and even rubber. So excellent has been the work that the Government has in the last two years translated certain of the specifications into foreign languages, thus making the society work a helpmeet in the extension of American foreign trade.

Professor Marburg's Influence

What Marburg's influence has been on the society's work cannot be exaggerated. Until Dr. Dudley's death in 1909 the two were as one in directing the body. By that time the principles on which the organization was based were well established, but the very rapid extension of the society since then has raised grave problems which have made the conduct of the organization no less trying than in its earlier years. Supported, it is true, by strong men, Marburg nevertheless bore the brunt of the handling of these situations, and it can be truthfully said that the society was his—his in the sense that his personality more than that of any other individual was determinative of its methods and of its work. His organizing genius, his sound judgment as to the problems to be attacked, his thoroughness, his honesty, are indelibly stamped on the organization, its committee work and its publications.

A good fighter, he was nevertheless openminded. Both qualities sprang from his high standards of honor. Many differed with Marburg; no one ever doubted his honesty. More than once important points, bitterly contested, were settled quickly because he expressed his



view. Time and again tense situations were relieved by his word.

His honesty, too, was the quality which saved him from difficulties which ordinarily would come to a man of his temperament. He would hardly be called a diplomat. He was too impetuous, too anxious to get results, too full of energy to use indirect or slow methods.

His energy and enthusiasm, qualities which counted heavily in his work both at the university and in the society, are responsible for his untimely end—he was but 54 years old. He threw himself with vigor into every task he took up. He never saved himself, and his strength was unequal to the strain he willingly imposed.

As a Teacher.

While the profession knows him chiefly for his work in the society, he was no less successful as a teacher. Strict in his handling of students, he turned out thorough men, imbued with high ideals and a sense of their professional responsibility. No man who was in school under the "Duke," as they fondly called him, but will feel that he has suffered a heavy, personal loss. In conjunction with his colleague in mechanical engineering, the late Prof. Henry W. Spangler, he deserves credit for having planned the excellent engineering laboratories of the university.

The principal of his writings was his book on "Framed Structures and Girders," published in 1911. This volume, on stresses, was to be the first of three under the general title named, but he never found time to complete the work. For years he was a contributor of editorials to the *Engineering Record*, and was one of that journal's most valued advisers.

He was a member of the American Society of Civil Engineers, past president of the Engineers' Club of Philadelphia, past secretary of the Society for the Promotion of Engineering Education, and past chairman of the committee on science and arts of the Franklin Institute. He was honored with the degree of doctor of science by the University of Pennsylvania and of doctor of laws by Franklin and Marshall College.

Few men have done more for American engineering than Marburg. None has carried to his grave greater affection or more sincere admiration. His departure creates a great void in the engineering world.

E. J. M.

Appreciations.

[The following appreciations are from men who had the privilege of working with Professor Marburg and of observing him at close range.—*Editor.*]

"Few men have accomplished as much as Edgar Marburg. Through the sixteen years he acted as secretary-treasurer, much of the wonderful vigor and remarkable accomplishments shown by the American Society for Testing Materials has been due to his energy, vision and character. While his personal work on the technical committees of the society has been large and fruitful, by far his greatest contribution is the influence which he has exerted on the spirit and policy of the society and the relations which should control in the organization and its committees. Particularly has his insistence upon fairness and justice, his aversion to commercialism, and his conscientious guarding of the good name of the society had a marked effect on the organization itself and on the business world. It cannot be said too strongly that he has exercised a strong and far-reaching influence upon that part of engineering which deals with the materials of engineering and business relations connected with their manufacture and purchase.

"His distinguished service in this field should not be permitted to obscure his notable work in engineering education where most of his time and effort has been directed and where, although perhaps less well known to engineers generally, his accomplishments are of themselves worthy of the highest commendation."—*A. N. Talbot, president, American Society of Civil Engineers, past-president, A. S. T. M.*

"That the executive Committee (of 1902) chose wisely and well we all know. The happy selection made at that time has been a source of great satisfaction to those who made it. Much of our success has been due to Doctor Marburg's devoted interest in the society and its work, his untiring energy, his rugged honesty, his fair-mindedness, and his jealousy of its good name. Those of us who, by our good fortune as officers and members of the executive committee, have been closely associated with the Doctor are in a position to realize more fully than is possible for others how many rocks and shoals have been avoided by his keen foresight."—*A. A. Stevenson, past-president, A. S. T. M.*

"Professor Marburg was a close friend to me, and just now my dominant feeling is one of profound loss. His energy flowed in many channels—of teacher, author, researcher and organizer, in all of which his unusually critical sense of real values was evident. Several substantial researches on materials and structures were his personal work. He built up a testing laboratory of the first rank at the University of Pennsylvania, from which significant results have come and which has had that helpful contact with technology characteristic of a live laboratory. The higher standard which his influence imposed upon the work of testing materials is of chief note in an unusually productive life."—*W. K. Hatt, professor of civil engineering, Purdue University.*

"The selection of Marburg as secretary of the American Society for Testing Materials was one of those timely and judicious decisions which have great influence on the development of such an organization. It was apparent to those interested in developing the society that the secretary must have a good knowledge of engineering materials, be well acquainted with the leading men in the engineering field, have a good business training, and be widely known as entirely independent and fair-minded. The selection of Marburg was due to the recognition of his possession of all these qualifications. He was well known as one of the leading structural specialists among the younger engineers, he had a thorough business training with the Carnegie companies, in the course of which he acquired a wide circle of acquaintances, and his position as professor of civil engineering at the University of Pennsylvania was

a guaranty of his independence. When he was chosen, all knew that a good selection had been made, but only those who have seen the society grow from its first inception can fully realize that this development has been very largely due to the wisdom of those who turned its executive management over to Marburg and kept it in his hands ever afterward."—*John M. Goodell, former editor of Engineering Record.*

"Doctor Marburg's chief characteristics were his honesty and his concentration on the objects to be attained. He devoted a life of vigorous and strenuous effort to the American Society for Testing Materials, marked by the greatest and sincerest devotion to the objects of the organization. His work in the society was distinguished not only for his adherence to broad views of the results to be attained in the testing of materials, but also to his able handling of the details of the personal and diplomatic intercourse with the many and varied interests represented."—*Robert W. Lesley, past vice president, American Society for Testing Materials.*

American Concrete Institute Convention

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in strength and wear from 1 min. to 10 min. of mixing time that the increase was hardly enough to warrant its use economically. Thus there is an increase in strength of about 10% from a ¾-min. mix to a 1-min. mix and an additional increase of 10% for a 2-min. mix. The author therefore concludes that a full 60-sec. mix in the drum is all that should be required.

As to rate of revolution of the drum the studies show that there is a slightly rising curve of strength up to 18 r.p.m. after which the strength decreases so that 30 r.p.m. is about the same as 7 r.p.m. The 18 r.p.m. happened to be the speed recommended by the mixer manufacturer. Other tests showed that both strength and wear decrease with the wetness of the mix but that the relation between strength and wear does not continue uniform. However, curves have been prepared which relate wear, strength and water content, so that for a given condition any two can be predicated from the other one.

The paper contains many valuable diagrams and tables which will appear in the final "Proceedings" of the American Concrete Institute.

Effect of Age and Storage on Concrete Strength

Long-time tests on concrete were reported to both the joint session and to the American Concrete Institute. With few exceptions they show that concretes have little change in compressive strength after the first year or two when stored in air but in a moist medium the regular increase in strength will continue at least up to two and perhaps beyond five years. Prof. D. A. Abrams (Lewis Institute, Chicago) in an American Society for Testing Materials paper gave the results of a résumé of many long-time tests taken from available literature. These all showed a progressive increase in compressive strength up to one or in some cases two years with a slight falling off or continuance of strength beyond that period. When plotted to logarithmic curves, however, these data showed a characteristic straight line curve reducible to a formula with two constants dependent on material, manufacture and storage. The tests are all in compression and Professor Abrams said that the usual briquette tension test is of little value for long-time tests because the shape of the piece is such as to set up tearing stresses after the concrete has completely hardened.

In discussion, P. H. Bates (Bureau of Standards) said that selections of published tests could be made which would show a decrease in concrete strength at and after the five-year period.

Before the Concrete Institute H. F. Gonnerman reported tests made at the University of Illinois on compression cylinders over a period of five years in dry air and under moist conditions. His conclusions are as follows:

1. The strength of the concrete which was stored in contact with moisture increased rapidly up to an age of 1 year; the increase in strength at ages greater than 1 year, although considerable, took place at a much less rapid rate.

2. The air-stored concrete attained nearly its final strength at a comparatively early age and gained little strength with the lapse of time.

3. The concrete which had been stored in air for a considerable time increased in strength greatly after it had been stored in contact with moisture so that further hydration of the cement could take place; the strength of the specimens stored in damp sand 2 years and 8 months after they were 2 years and 4 months old was 1.46 times the strength of the specimens which remained stored in air for 5 years.

4. The strength of the concrete at an age of 7 days for both damp sand storage and air storage was about 70% of the strength at 28 days; at an age of 1 year the strength of the concrete stored in damp sand was about twice as strong as at 28 days and the air-stored concrete was only 10% stronger than at 28 days. At an age of 5 years the strength of the concrete stored in damp sand was about 2.5 times the strength at 28 days and the strength of the air-stored concrete about 1.3 times the strength at 28 days.

5. At ages of 3 and 5 years the strength of the concrete stored in damp sand was about 1.9 times the strength of the air-stored concrete.

New Abrasion Test for Road Materials

In testing stone, gravel and other aggregate for roads in the standard Deval rattler it has been found that a proportionate relation between soft and hard stone could not be determined because of the cushioning effect of the dust which forms in the rattler. Thus the ratio of a soft to medium stone which in the standard test is 1.95 became 2.41 when the dust was removed as fast as formed. To avoid this difficulty Prof. H. H. Scofield (Purdue University) his devised a Deval rattler which has $\frac{1}{16}$-in. openings between the staves to allow the dust to escape. Examples of some of the tests, given in the paper, show a greater range of results and consequent better differentiation of quality than in the regulation test. Professor Schofield presented his conclusions in a paper read before the American Society for Testing Materials convention this week.

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Trained Nurse and Field Hospital Reduce Labor Turnover

HURT men return to work sooner, damage suits are less frequent, serious results from minor wounds are decreased and the morale of workmen is raised, on a large Chicago building job, by a trained nurse and a 14 x 16-ft. field hospital.

About a thousand workmen are employed. The hospital is a room in the corner of a warehouse. It has two large windows; the walls and ceiling have been painted white and the windows fitted with plain wire muslin curtains. The floor is of hardwood, and can be always kept clean easily.

The furnishings of the room consist of one steel hospital cot; one operating table; two instrument stands (of enameled steel); one porcelain lavatory (hospital model); one hospital water receptacle; four glass jars (containers for sterilized bandages, absorbent cotton and swabs); one desk and desk chair, and two enameled chairs.

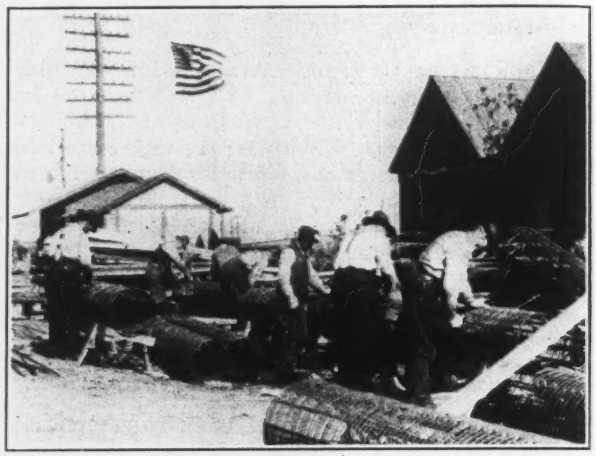
The accessories are two stretchers; one mattress and pillow; one wool blanket; six sheets and six pillow cases; two dozen hand towels; two simple forceps; one curved and one straight scissors, disinfectants, simple drugs, etc. The cost of the outfit was about $300. The wages of the nurse are about those of a skilled workman, say $30 a week.

In the operation of this hospital the nurse receives all cases from the job whether sickness or injury cases. She gives the aid which is necessary. If it is a surgical case, she superintends the preparing of the patient for the surgeon and the hospital. For minor cuts and bruises, she gives a dressing and either sends the patient back to work or to his home for a short period, as she deems best. These minor cases also report to her daily for attention and inspection, so that there is no chance for dishonest employees to take advantage of the employer.

The records show that from 45 to 100 cases of one kind or another are treated here daily. These include everything from a sliver in the hand to fractures of limbs, broken heads and surgical dressings. A complete set of records and reports of all cases and treatments are kept, and all fatal and accident liability reports which are required by the Government and the state are handled.

Low Benches Eliminate Stooping When Assembling Column Spirals

TWO low wooden horses set parallel and fastened together form a convenient bench for assembling column spirals, at the new quartermaster's depot under construction at Chicago. Altogether, 2856 spirals, for columns ranging from 48 in. to 36 in. in diameter, had to be assembled. As is customary, these spirals came



MEN WORK BETTER WITH LOW BENCHES

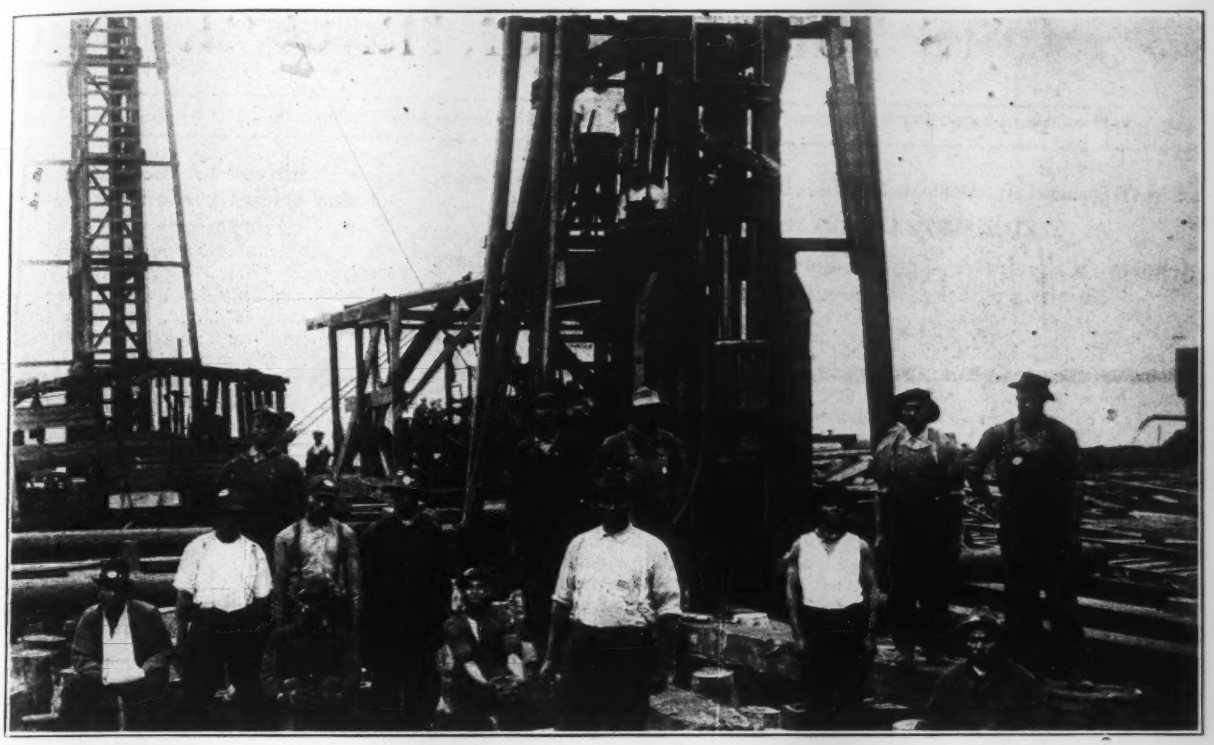
knocked down and flat, and each had to be "opened out" and have ten ¾-in. rods inserted and wired to the circumferential rods. By means of the bench the men could do their work without stooping, and their output was increased. Incidentally, the 408 columns of the building contained 5½ miles of reinforcing rods. The contractors are the E. W. Sproul Co., Chicago.

Latest Hog Island Pile Record Preceded by Consistent Work

WITHOUT special preparation and working part of the time in a thunderstorm that sent every other workman on Hog Island to cover, Edward Burwell and his colored crew of 11 men drove on June 12 220 piles, averaging 65 ft. long, in 9 hours and 5 minutes. The occurrence of the odd minutes did not result from a second thundershower. Burwell stopped because he had driven the last pile in shipway No. 46, which was also the last pile in the 10 ways of group No. 5, the section of the Hog Island plant being built by the Arthur McMullen Contracting Company.

The record believed to have been established was not, according to officials of the American International Shipbuilding Corporation, accomplished at a sacrifice of efficiency, but was the star performance of one among many gangs which have all shown extraordinary averages throughout the work. In support of this are cited the performances of William Gordon of the Hugh Nawn Contracting Co., 140 piles 60.6 ft. long in 9¼ hours on May 25; of Robert Sutton, who drove 165 piles 62 ft. long for the Raymond Concrete Pile Co. in the same time on May 10, and the recent work of a night crew of 24 men which cut off 327 piles with crosscut saws in 9 hours. Moreover, Burwell's crew averaged for six months from January to June nearly 43 piles a day, the average length of which was 58½ feet.

Burwell has been driving piles 15 years and estab-



COLORED CREW OF EDWARD BURWELL WHICH DROVE 220 PILES ON JUNE 12 AT HOG ISLAND

lished his record as a direct result of the rivalry which began with earlier claims for the honor. His equipment consisted of a Vulcan No. 1 hammer and a skidding-rolling machine, with a three-drum, 9 x 10 hoisting engine, both hoist and hammer being driven by compressed air. Average conditions prevailed. A good supply of piles was available, but no special preparation had been made for their piling or placing. From 7 a. m. until 12 m. 127 piles were driven. Thirty minutes were taken for lunch. At 2.30 p. m. 175 piles were in and the yard's standing record broken. During over an hour of this time Captain Burwell and his crew, stripped to the waist, worked through a drenching thunderstorm, as stated. At 4.35 p. m., with 220 piles driven, a total of 14,260 linear feet for 9 hours and 5 minutes, which is believed to be a world's record, Captain Burwell ordered the driving stopped for the excellent reason that the last pile had been driven.

Captain Burwell's log, for the day on which the record was made, reproduced herewith, presents some interesting details.

LOG OF RECORD DAY'S WORK.

7.00 A. M. — 8.00 A. M.	27 piles.
8.00 A. M. — 9.00 A. M.	23 piles.
(Delay 4½ minutes due to broken steam line; raining very hard from 8.15 a. m. to 10.00 a. m.)	
9.00 A. M. — 10.00 A. M.	28 piles.
10.00 A. M. — 11.00 A. M.	22 piles.
(Delay 8 minutes due to pile fall breaking.)	
11.00 A. M. — 12.00 A. M.	27 piles.
12.00 Noon — 12.30 P. M.	lunch.
12.30 P. M. — 1.30 P. M.	25 piles.
(Heavy rain with electric showers from 1.25 p. m. to 2.50 p. m. 1.25 p. m. to 1.40 p. m. air pressure dropped considerably, which held up hammer.)	
1.30 P. M. — 2.30 P. M.	23 piles.
2.30 P. M. — 3.30 P. M.	23 piles.
3.30 P. M. — 4.35 P. M.	22 piles.
9 hours and 5 minutes	220 piles.

Officials and inspectors of the American International Shipbuilding Corporation and of the Arthur McMullen Contracting Co. were interested spectators of this pile-driving feat and the figures and data have been carefully checked and recorded.

Lever and Street Car Pull Sheet Piles

IMPROVISED methods of pulling sheet piles were used at the Macomb St. bridge in Mt. Clemens, Mich. The circular cofferdam for the pivot pier had two rows of 9-in. T-girder rails. Those of the outer row were placed in radial position and alternated with heavy planks driven between the webs. Those of the inner row had their webs in a circumferential line, the heads and flanges being connected by lugs and clamps.

To pull the outer rails, a heavy timber was rigged as a lever, with its short end hooked to a hole in the rail web while four to six men on the long end kept the lever "teetering" until the pile came loose. At the same time a man with a sledge hammer struck the rail to help jar it free. When it was loosened, it was pulled out by means of a chain hoist hitched to the bridge.

For pulling the inner ring a work car of the electric interurban railway was used. A rope hitched to the car on the bridge was led through a snatchblock hooked to the handrail, then down through an open panel in the cement sidewalk to a snatchblock at the water's edge and then back to the cofferdam. This rope was attached to a ring fitted to a hole in the web of the rail. By moving the car forward the rail was pulled sideways and torn away from its next neighbor. When thus loosened it was pulled up by means of the chain hoist and lowered upon a raft. Men with rail tongs carried it on a working platform to the shore.

NEWS OF THE WEEK

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Testing Materials Convention Marked by Record Attendance and War Activities

Reports on Steel, Brass and Industrial Research Prominent—Late Sessions Shocked by Death of Secretary Marburg

War's impress gave unusually serious character to last week's annual convention of the American Society of Testing Materials at Atlantic City, and hurried its activities in spite of a long program. The total attendance exceeded even the high figure of 569 reached last year; nearly 580 men registered during the four days, June 25-28. Some of this large attendance may be chargeable to the fact that two other societies met in Atlantic City at the same time, the American Institute of Electrical Engineers and the American Concrete Institute. The latter joined with the Testing Materials Society in one session, when tests of concrete were discussed.

Word of the death of Prof. Edgar Marburg, secretary of the society since its foundation in 1902, reached the members while the evening session of Thursday, June 27, was in progress. It came as a profound shock, despite general knowledge of the fact that Prof. Marburg had been dangerously ill for some weeks. After Past President A. A. Stevenson had announced the news, a committee of three men long identified with the most important activities of the society was named to draft a memorial resolution. The text of this resolution is printed on page 59.

As in prior years, the society's deliberations were marked by active attention to the work in hand, but with the war spirit superadded to the technical purpose. Many members being engaged in war service, and much of the committee work having some contact with war conditions and requirements, the reports were disposed of in quick, matter-of-fact fashion, and the members concerned with a given subject left the convention soon after that subject was closed.

Chemical Limits For Steel Modified Temporarily

An important relaxation of the chemical limits in steel specifications was prominent among the war contacts of the meeting. The steel committee last January considered the newly-arisen difficulty of holding phosphorus and sulphur down to the limits fixed in the standard specifications, and discussed the advisability of raising the limits while conditions remain as they are. However, it recommended, instead of change in the standard specifications, that buyer and seller make the desired modifications by special contract, and that all parties be requested to keep full records of analyses and qualities of material, as data for future revision of the specifications. Subsequently it developed that this conclusion should be reconsidered. At the June meeting of the committee, therefore, the amending clause given below was voted upon and adopted; it received the sanction of the society at the annual meeting. It reads:

"In view of the abnormal difficulty in obtaining materials in time of war, the rejection limits for sulphur in all steels and for phosphorus in acid steels shall be raised 0.01% above the values given in the specifications. This shall be effective during the war and until otherwise ordered by the society."

This clause is to be printed under the title of each specification containing chemical requirements *except* those for boiler and firebox steel and those for boiler rivets. Further, as regards sulphur the note shall not apply to the specifications for carbon steel car and tender axles.

Symposium on Industrial Research

Industrial research, also a war subject because war experiences here and in England have centered attention on the subject, was made the theme for a special session. The importance of organized action in such research was emphasized strongly by prominent students of materials and testing. An abstract of two of these addresses appears on page 45 of this issue.

Munitions manufacture troubles in recent times brought the season-cracking of cold-worked brass again to the fore. Cracking of cartridge cases has caused some loss. The prior experiences with similar cracking of brass and bronze parts in the Catskill Aqueduct and in a Minneapolis filter led to study of causes and search for a cure at the Bureau of Standards and elsewhere, and these studies were further energized by the new troubles. Annealing as well as certain cold-distortion treatments have been found to be remedies.

Abstracts of several interesting discussions of the subject will be given in a later issue.

American Engineering Standards Committee

Progress made since the inception of the American Engineering Standards movement last summer led recently to the formulation of a final draft of a constitution for a standards body in which the principal technical societies

(Concluded on p. 58)

Many Ships to be Launched Today from Government Yards

American shipyards, operating under the United States Shipping Board and Emergency Fleet Corporation, will celebrate the July 4th holiday this year by launching 89 ships, having a total dead weight tonnage of 439,886, according to a statement issued by the Shipping Board. These launchings amount to about one-third more than the production of tonnage from American shipyards during the fiscal year 1915-1916 and exceed by 42,050 dead-weight tons the launchings for the entire year of 1901, which was the record pre-war year in American shipbuilding.

The launchings set for today will exceed the amount of tonnage launched during the month of May by more than 95,000 dead-weight tons, according to present expectations. The 89 ships which are to be launched today include 37 steel vessels and 52 wooden ships of various designs. It is even expected that the number of 89 may be exceeded.

Thirty-Nine Killed in Collapse of Building at Sioux City

Thirty-nine lives were lost and $100,000 property damage was done when a four-story brick building collapsed in Sioux City, Iowa, at 1:30 p.m. June 29. The building was forty years old and a portion of it was undergoing remodeling. The first floor had been lowered about 10 in., but this work is reported to have been completed and the jacks removed.

The adjoining building was completely crushed by the falling walls, and fire broke out immediately, accompanied by several explosions. Reports vary as to whether the principal explosion occurred before or after the collapse, but the most reliable evidence is said to indicate that the explosion followed the failure of the building and that the walls appear to have crumbled at the base, causing the building to settle.

Engineers' Advisory Board to Help Employment Work

Fifteen engineers met June 28 in Chicago in conference with the heads of the new division of engineering, United States Employment Service, to define an engineer and an engineering draftsman, for classification purposes, also to discuss ways and means of getting a complete register of engineers. Several definitions were submitted, in each of which there seemed to be a common thread of service to humanity and an attempt to modernize Tredgold's defi-

nition. The outcome was instructions to a committee consisting of E. T. Perkins, Isham Randolph and Prof. C. F. Harding to edit a one-sentence definition embodying the following: An engineer is one who is qualified by education and experience to plan, design or direct engineering work with economic efficiency, and capable of organizing and directing men, to the end that the physical properties of nature may be adapted to the needs of mankind.

It was decided that a survey of the needs of industry for engineers and the members now employed be obtained through coöperation with the surveys undertaken by the War Industries Board. This will be tried out first in Zone No. 9, Illinois, Indiana and Iowa. Simultaneously with this work, registration lists obtained by engineering societies and universities are solicited and will give the division something on which to start. The necessity for the census data on supply and demand is pressing at this time, as rumors are rife to the effect that four positions are open to every engineer while men are unable to find places commensurate with their ability.

W. H. Finley, president of the Chicago and North Western Ry. Co., chairman of the conference, was authorized to appoint a permanent engineers' advisory board to consider means of handling classifications and furthering the registration.

Federal Control of Hudson River Bridge Permits Upheld

The Supreme Court of New York June 28 handed down a decision affirming the right of the New York Central R. R. Co. to build a Hudson River bridge at Castleton on the plans approved by the Secretary of War, regardless of the action of the New York legislature requiring the bridge to be built with a 1000 ft. span. The court declared that the primary Federal jurisdiction over navigable waterways cannot be interfered with by any state, and, the Federal authorities having established the restrictions which shall control any project, the state has no authority to impose any other restrictions.

Chief of Construction Division Becomes Major General

Richard C. Marshall, Jr., chief of the Construction Division, U. S. A., is included in the list of 43 major generals appointed June 28 by Presidential nomination. General Marshall has been connected with the construction work of the army ever since the beginning of the war, first as assistant to Brigadier General Littell, of the cantonment division of the Quartermaster Department, and later as head of the construction division when the cantonment division was changed to the latter some months ago. He is a Virginian, and entered the service from civil life. He is 39 years old.

Concrete Institute Meeting Emphasizes Ships Housing and Building

Lively Interest Displayed in Wartime Measures Though Average Attendance Was Decreased

With an attendance cut almost to half that of the past few years, the postponed annual meeting of the American Concrete Institute at Atlantic City, June 27-29, made up in interest what it lacked in attendance. Even with the comparatively small average attendance, the last session of the seven crowded a large assembly room in testimony to the great interest among engineers in the subject of concrete ships. The meeting had been postponed from its regular time of February because of the rail congestion at that time. It took place at the Hotel Traymore, at the same time as the meeting of the American Society for Testing Materials, with which a joint session devoted to concrete was held. At this session, alternate papers of the two societies were presented and though almost everybody in attendance belonged to both societies, the discussion seemed to take on unusual vigor, testifying to the wisdom of the joint session.

Committee work during the past year was almost at a standstill, owing to the wartime activities of the various committee members. Only two committees presented any changes in the standards of the institute. The Committee on Roads and Pavements made some minor changes in wording, which were adopted by the convention and sent to letter ballot. The committee on concrete sewers presented a revised report for adoption, but on account of many criticisms of details of the concrete provisions in the specifications the meeting voted to return the report to the committee for further revision. The reports of the other committees were entirely on progress.

Concrete Ship Interests Many

The session on concrete ships was made doubly interesting by a number of moving pictures, showing among other things the launching of the "Faith" in San Francisco, the famous upside-down launching of the little Norweigian boat and a number of the detailed operations in one of the United States Government concrete-ship yards. These latter were taken by the concrete ship department to be shown to the designers in the home office, so that they might be acquainted with the difficulties of field work, and were not intended for general display, but on account of the intimate detail they showed of the work were much appreciated by the audience.

The report of the committee on concrete barges and ships, which is a joint committee of the American Concrete Institute with the Portland Cement Association, was published in *Engineering News-Record* at the time it was presented to the latter association last fall. It is now somewhat out of date, so quick has been the development of the concrete-ship idea, but it is valuable as an indication of early investigations and for the design of the standard barge which it contains.

The main paper of the evening was entitled "Principles of Design of Concrete Ships," by R. J. Wig, chief engineer of the department of concrete ships, and S. C. Hollister, engineer of design. It is a remarkably good exposition of the elaborate details required for the design of ships and particularly of concrete ships, and it outlines the thorough study that the concrete ship department has made in the subject. This paper, which was read by Mr. Wig, took up a large part of the evening and was followed by the moving pictures referred to. It was preceded by a historical paper on concrete ships by J. E. Freeman of the Portland Cement Association, and was followed by a brief presentation of a paper by L. L. Livingston of the L. L. Brown Co., of New York, on concrete barges. This paper described in some detail the reinforced-concrete barge built by the company last year at Peekskill, N. Y., a deck barge intended originally to be placed with a cement gun, without the use of interior forms. This practice was carried out for the lower section, but was discarded for the upper work in favor of poured concrete.

Another paper by A. G. Monks, of the firm of Monks & Johnson, consulting engineers for the Liberty Shipbuilding Co., which holds a Government contract for concrete ships, described the Government yard at Wilmington, N. C. The paper was read only by title. Discussion on concrete ships was comparatively light, the audience very evidently being there in search of information and not to give it.

Concrete Housing Discussed

Another session was devoted entirely to the subject of concrete houses. This session was in charge of the committee on industrial concrete housing, of which Leslie H. Allen, of the Aberthaw Construction Co., Boston, is chairman, and consisted of the presentation of the report of the committee and of various papers by the different members of the committee, taking up the different ends of the housing problem.

A final paper by Lieut. K. H. Talbot on the "Method of Construction of Concrete Houses" gave full and valuable information on the different kinds of forms, methods of placing concrete

(Concluded on p. 59)

Testing Materials Convention

(Concluded from page 56)

of the country shall coöperate. This draft was laid before the society through the executive committee, and was approved for submission to letter ballot of the entire membership on the question of the society's participation. Past President Stevenson represented the American Society for Testing Materials in the work of preparing the constitution.

Pipe threads were taken up by the society several years ago, and a committee was appointed to join with other societies in revising the existing thread standards. As this subject is out of the field of materials, question arose later whether it came within the proper scope of the society's work. The final conclusion was expressed in a report of the pipe-thread committee recommending that the subject be abandoned and left to the American Society of Mechanical Engineers, to whose field it belongs. This recommendation was approved by the meeting.

Specifications for Metals

Outside of the significant change in sulphur and phosphorus limits already mentioned, the steel committee, largest and most active of the society's committees, reported fully as much work as usual, in study and revision of standard specifications. With one exception, all recommendations concerned the revision of existing standards or the promotion of tentative specifications to the rank of standard, and the meeting gave its approval with virtually no discussion.

Urgent war conditions led to preparing the single new specification, for cast-steel anchor chain. A threatened shortage in wrought chain led to active study in several iron works of the possibilities of cast chain, and highly successful results were attained. The committee then made tests of the new material and drafted specifications to govern its acceptance, which were laid before the society's meeting and accepted as tentative.

Revisions of wrought-iron specifications were also approved by the meeting. The committee on cast iron recommended increasing the sulphur limit in light gray-iron castings from 0.08% to 0.10%; this was approved, and the committee's tentative soil-pipe specifications were approved as standards, subject to letter ballot.

In the field of non-ferrous metals also a remarkable amount of work was done. Regrading of railway bearing metals gave rise to some discussion. Eight tentative specifications were advanced to the grade of standard, subject to letter ballot. New tentative specifications were presented on cartridge brass and disks, naval brass rods, bronze bearing metals for turntables, and babbitt metals, and for methods of analyzing manganese bronze and gun metal.

Nothing new was reported in the fields of cement and reinforced concrete. The cement committee declared itself not yet ready to recommend further action on the tests for compressive strength of mortar which were accepted as tentative two years ago.

On building tile, the committee in charge reported progress, results of tile tests showing crushing strengths of 1000 to 5000 lb. per square inch, and stated that tests of tile walls are in progress.

The committee on refractory bricks reported further work on test methods for refractories.

Acrimonious discussion arose when the committee on clay and cement sewer pipe reported, recommending slight revisions in the present tentative specifications. E. Ashton and W. M. Kinney attacked the committee sharply for declining to eliminate the absorption limits of 5% for clay and 8% for cement tile. Recent tests in Philadelphia having indicated that these limits are probably too low, they demanded that the figures be stricken out. Mr. Ashton accused the committee of having reversed the general method of making specifications, and characterized its work as being contrary to the spirit of the society. Mr. Kinney intimated that the last meeting of the committee was "packed" by the clay men through their securing the proxies of two non-producer members, and also charged that in the makeup of the committee the clay interests with six members outweighed the cement interests with five—a charge admitted by the chairman, R. Hering. Endeavors to force the dispute back into the committee room failed. The controversy was based on the use of the society's tentative specifications as a standard by the city of Los Angeles. G. H. Tefft, representing the clay interests, C. L. Warwick and Cloyd M. Chapman also engaged in the discussion. In the vote the cement-tile representatives won the victory, the absorption figures being deleted from the specification.

Two new detail specifications for paint materials were presented by the committee on preservative coatings. Due to war activities of its members, this committee, usually very active, did only a moderate amount of work.

Highway Materials

Water-gas tar treatment of wooden paving blocks produced some discussion when the timber committee reported. In proposing tentative specifications for blocks, the committee omitted clauses for quality of water-gas tar oil, but placed them in an appendix "for information." Objection was raised in the meeting, and on vote these clauses were inserted as a footnote in the body of the specifications. Other highway matters were dealt with by the committee on road materials. Besides revision of several of its specifications this committee presented (as tentative) a new specification, for tests of apparent specific gravity of fine non-bituminous highway materials. It also recommended that six tentative specifications be advanced to the rank of standard, which course was approved by the meeting.

A distinct forward step was recorded by the committee on fireproofing, which during the year succeeded in bringing together all the interested technical societies in the joint preparation of a standard code for the conduct of fire tests and fire-stream tests. Under the new code, fire-protective materials are classified by their time of endurance in the fire test as one-hour protection, etc. War-service buildings of temporary character and of combustible construction, as storehouses (and even hospitals!) have made evident the importance of recognizing short-time protection, such as lath-and-plaster partitions. On this account 15-min. and 30-min. protection are recognized in the code. The meeting approved the code for letter ballot on its adoption as standard.

Reports of Technical Committees

Other technical committees reporting were those dealing with magnification scales for micrographs, textile materials, magnetic properties, lubricants, coke, waterproofing, insulating materials, shipping containers, rubber products, and methods of testing.

Papers covering a large range of subjects were read. The two topical discussions, already noted, included the following contributions: On industrial research, papers by Prof. H. M. Howe, John Johnston, A. D. Little, Charles L. Reese, Frank E. Gorrell, A. D. Flinn, and J. S. Unger; on season and corrosion cracking of brass, papers by Prof. William Campbell, W. H. Bassett, H. S. Rawdon, W. Reuben Webster, W. B. Price, P. D. Merica and R. W. Woodward. Other subjects represented include testing methods and appliances (4 papers), aircraft materials and tests of parts (2), steel (3), chemical analysis (1), concrete and stucco (5), tile, stone and the like (4), and lubricating oils (3 papers).

New Officers Elected

The society elected the following new officers: President, G. H. Clamer, of Philadelphia; Vice-President, George S. Webster, of Philadelphia; Members of Executive Committee, G. Aertsen and G. B. Heckel, of Philadelphia, G. K. Burgess, of Washington, and K. W. Zimmerschied, of Detroit.

By raising the membership dues two years ago the society reclaimed its finances very successfully. At the end of 1915 a deficit of $6400 was recorded; this has been converted into a surplus of nearly $12,000 (end of 1917). The membership increased in spite of the raising of the dues, however, and at the present time the total is 2261, including 224 junior members.

Improved administrative machinery is to be provided by the appointment of an assistant treasurer and an assistant secretary. An amendment to the by-laws creating these new offices was accepted and referred to letter ballot.

Memorial Resolutions on Death of Professor Edgar Marburg

Resolutions upon the death of its secretary, Prof. Edgar Marburg, were adopted by the American Society for Testing Materials at its first session after the news of Dr. Marburg's death was received. A committee of three past presidents of the society drafted the resolutions. Their text follows:

"The American Society for Testing Materials in annual meeting assembled learns with profound sorrow of the death of its esteemed secretary-treasurer, Edgar Marburg, on June 27, 1918.

"In this hour of bereavement the society desires to place on its records an acknowledgment of the great debt which it owes to Edgar Marburg. By zeal, industry, loyalty, insight and high ability exerted through sixteen years as secretary-treasurer of the society, by guiding its actions, energizing its activities and guarding its name, he has exercised a powerful influence on the character, standing and usefulness of the society and on the making of specifications and tests for the materials of engineering. He is honored and revered as a master and leader. The imprint of his work will long remain.

"The society extends to the family heartfelt sympathy for their great loss. May the knowledge that his fine character, strong manhood and great work in the field of engineering are appreciated by the membership of the American Society for Testing Materials become a part of their many treasured memories of his life and work."

Concrete Institute Convention

(Concluded from p. 57)

and methods of finishing. The report of the committee is an abstract of the findings of the various representatives as given in their papers and outlines in brief fashion the present status of concrete house building, particularly for quantity production, such as is necessary in a housing development. The committee reported that work was hardly well under way, but expects in the coming year to gather some valuable data.

Tests of Buildings and Slabs

A third group of papers not delivered at the same session but of common interest were those on concrete tests. Most of these are abstracted elsewhere in this issue. Edward Smulski's tests on a spiral reinforced flat slab shows some very high values of resistance. In studying the tests consideration must be given to the fact that the load did not cover the entire test panel because of the necessity of leaving open a rather large space in order that the gage points on the big horizontal slab spirals could be reached. Uniform distribution of load was simulated by placing increased loadings around the edges of the openings.

Prof. W. K. Hatt read a paper containing an analysis of the general subject of moment coefficients for flat-slab design with special results on a large test panel built at Lafayette, Ind. He first analyzed a number of existing flat-slab and other tests in order to determine the relation between the total external moments in the steel stresses, finding that the percentage of load moment increases with the unit stresses in the steel but that it never reaches 100 per cent. in working conditions. These figures have considerable value in the study of flat-slab tests or in the preparation of a flat-slab theory. The figures given on his own test slabs are not complete but will be found in a later statement. They do indicate, however, certain load distributions of interest. Papers on fire-tested columns are abstracted elsewhere, as well as an elaborate paper by Prof. D. A. Abrams on the results of tests at the Structural Materials Laboratory, Chicago.

J. L. Pearson, of the United States Bureau of Standards, gave in some detail the present status of the well-known stucco tests being conducted by the United States Bureau of Standards.

Design Papers Less Numerous

Design papers were not so numerous. They included a very complete analysis of a reinforced-concrete chimney by J. C. Mingle, an analysis designed to permit anyone to carry through the design of the concrete chimney from the beginning to the end. A discussion of the stress in eccentrically loaded reinforced columns by L. J. Mensch, which was presented only by title, will appear in the Proceedings.

In construction work mention should be made of an analysis of the treatment of concrete surfaces by J. J. Earley, Washington, D. C. Mr. Earley has been working for some time over an ornamental concrete retaining wall at Meridian Hill Park in Washington. He has finally succeeded, by the use of exposed natural aggregate which is continuous through the wall and not merely the coating, in producing a uniform concrete texture of pleasing appearance.

Among important reports presented was that of the committee on the fire at Far Rockaway in a reinforced-concrete warehouse which seriously affected a great number of the concrete members about 18 months ago. The committee is of the opinion that while the gravel concrete may have spalled and cracked under the intense heat earlier than would concrete of some other aggregate, the heat was so intense and the steel so near the surface or in places exposed so that transmission through it would have caused expansion and cracking under any circumstances. The committee made a number of slab tests which will be reported later, showing that the repaired portions are stronger than the original structure. I. H. Woolson contended that the exposed steel would have little influence in transmitting heat to the reinforcement and that the damage was in fact due to the use of gravel concrete which expanded in the same manner as the columns tested by Mr. Hull and described in the convention.

Work of Three Committees

The committee on reinforced-concrete and building laws, which prepared the concrete specifications of last year that were ordered to be held over for a year, has had no opportunity to go very deeply into the matter this year, and recommended that the specifications hold over for another year. The committee states that it is studying the matter of shear in concrete and considers that there will be some wide revisions in the findings for next year. The report of the joint committee on fire tests of which I. H. Woolson is chairman, and on which the Concrete Institute had a member, was submitted to the institute for approval. On account of constitutional restrictions the specification, which had already been adopted by several of the other constituent societies, could not be adopted at this session, but it is to be printed in the "Proceedings" with an indication of the approval of the institute and is to be adopted as soon as possible. The committee on treatment of concrete surfaces presented the questionnaire which it had sent out to obtain information on stucco.

One session was devoted to the subject of roads, but with the exception of a paper on vertical change in the concrete pavement slab to subgrade movements, by J. W. Lowell, little of novelty was brought out.

Several papers on the details of certain concrete structures completed the program.

The institute is now in good financial state in spite of war conditions. It has issued all of its publications and will endeavor to get the new publications in the hands of its members at the earliest opportunity. Prof. W. K. Hatt, Purdue University, Lafayette, Ind., has been reëlected president for the ensuing year.

Robinson and Hallowell Retire from Stone & Webster

Dwight P. Robinson and John W. Hallowell have retired from the firm of Stone & Webster as of July 1, and the business will be continued by the remaining partners—Charles A. Stone, Edwin S. Webster, Russell Robb and Henry G. Bradlee. Dwight P. Robinson has been with Stone & Webster since 1893, from 1908 president of the Stone & Webster Engineering Corporation, and a member of the firm since 1912. John W. Hallowell has been with Stone & Webster since 1901 and a member of the firm since 1912. Since May, 1917, he has been in Washington with Mr. Hoover as a member of the United States food administration and expects to continue in that work for the duration of the war.

Engineering Educators Discuss Student Shortage

How to meet the increasing demands for engineers to carry on the war and industry now and to provide for the reconstruction period was the subject of much of the discussion at the convention of the Society for the Promotion of Engineering Education, held June 26-29 at Evanston, Ill. Prof. C. R. Mann, who outlined the forthcoming report of the Joint Committee on Engineering Education and also the latest decisions of the Government with reference to students' training camps, was the center of debate nearly the whole of one day. During the evening session engineers of the Western Society of Engineers and sections of the American Institute of Electrical Engineers and the American Society of Mechanical Engineers added their views, a joint meeting being held for the purpose of getting the opinions of the practicing engineer.

W. L. Abbott, chief engineer of the Commonwealth Edison Co., Chicago, detailed the methods by which the public service companies recruited engineers. Formerly a young graduate was put to work at $2 per day with the gang. At the end of the year the man might still stick, but not from any effort on the part of the company. His trustworthiness and eagerness to take responsibility were about the only things that would bring him to the attention of the employer. That day passed some years ago, as the recruits failed to materialize. This reluctance on the part of men to seek work was progressive from East to West, and finally the Central Station Institute was founded, in which 30 to 50 were trained each year. A charge of $400 a year was made and the men were paid $40 per month for the part time spent in the different departments. In four years 85 were graduated, one-half of whom stayed with the company until the war began, when 80% left, practically terminating the experiment.

Now the scheme is to give the men a large part of the preliminary work in five vacation periods while at school; only one-half day a week is given to classroom study. The pay is $60 to $90 per month. As before, the men are shifted often from one department to another. This is a serious drawback, because department heads are not enthusiastic about training "greenhorns" charged up to them only to have the new man transferred when he is ready to do productive work.

In his presidential address, on "Essentials in Engineering Education," (read by John F. Hayford) Milo S. Ketchum pointed out that the most critical problem in engineering education today is to obtain a sufficient number of competent teachers. No greater task can be undertaken by the society, in his opinion, than to improve the conditions and increase the emoluments of engineering teachers so that the engineering students may all have instruction under men of thorough training in theory and practice who can comply with the specifications for a good engineer. The address bristled with humanistic statements such as the following: "A man with a disagreeable disposition ordinarily has no opportunity to use his technical ability except in a very inferior position. One of the most important advantages gained from technical education is contact with other men and an appreciation of the value of human engineering. Of all the materials with which an engineer has to deal there is no material so difficult to handle and control as human material."

Detroit Adopts New Charter

Detroit adopted a new charter on June 25 by a vote of 32,690 to 4587. In place of 42 councilmen elected by wards there will be 9 elected at large. Other details were given in *Engineering News-Record* of May 30, p. 1047.

Real Estate Men Discuss City Planning

City planning received considerable discussion at the recent St. Louis convention of the National Real Estate Association, at which some 135 cities were represented. J. C. Nichols, Kansas City, urged that houses for war workers should be located to conform with a sensible city plan and to fit into a zoning system.

PERSONAL NOTES

JOHN M. GOODELL, who has been assisting the personnel division of the United States Shipping Board for the past six months, has been appointed consulting engineer of the office of Public Roads and Rural Engineering and will represent the office on the United States Highway Council. Mr. Goodell was formerly editor of *Engineering Record*. For some months at the beginning of the war he assisted in the organization of the work of the Committee on Public Information.

FREDERIC A. DELANO has tendered his resignation as a member of the Federal Reserve Board to accept a commission in the Corps of Engineers, United States Army, to engage in railroad construction and management in France. It is understood that Mr. Delano has been offered a commission of high rank in connection with military railroad supervision in France. Before his appointment to the Federal Reserve Board in 1914 he was president and receiver of the Wabash R.R. from 1905 until 1913, when he became president of the Chicago, Indianapolis and Louisville Ry. Previously he had twenty years' experience in railroad work in the service of the Burlington.

WILLIAM A. MCGONAGLE, president of the Duluth, Missabe & Northern Ry., has been appointed Federal general manager, with headquarters at Duluth, Minn. Previous to 1902, when he became assistant to the president of the Duluth-Missabe road, Mr. McGonagle was assistant chief engineer of the Duluth & Iron Range Railroad.

JAMES P. MURRAY, for the past five years engineer in the State Reclamation Department of Texas, has been commissioned as captain in the Engineer Reserve Corps.

A. T. HARDIN, vice-president of the New York Central R.R. Co., has been appointed assistant Federal regional director, Eastern territory, with headquarters at New York City. After his graduation from the University of South Carolina in 1894 with the degree of civil engineer, Mr. Hardin entered the maintenance of way department of the Southern Ry., and later entered the engineering department of the New York Central & Hudson River R.R., becoming engineer maintenance of way in 1903.

C. E. TILTON has been appointed city engineer of Phillipsburg, N. J.

W. C. KEGLER, engineer maintenance of way, Cleveland-Indianapolis division of the Big Four Ry., has been appointed district engineer in charge of construction with headquarters at Galion, Ohio.

W. A. BALDWIN, general superintendent of the Erie Lines West and previously division engineer, has been appointed transportation assistant to the Federal manager and will have authority over such transportation matters as were in charge of the general manager under private control.

V. R. PARKHURST is in charge of drainage work at Camp Funston, Kansas. Mr. Parkhurst was formerly consulting engineer for the Shawnee County Drainage Board, Topeka, Kan.

R. J. MIDDLETON, valuation engineer of the Chicago, Milwaukee & St. Paul Ry., who has been appointed assistant chief engineer of the Chicago, Milwaukee & Puget Sound Ry. with headquarters at Seattle, as mentioned in *Engineering News-Record* of last week, was graduated from the civil engineering department, University of Arkansas, in 1903. Mr. Middleton entered the engineering department of the Chicago, Milwaukee & St. Paul as a draftsman in the bridge and building department in 1906, and in a short time was promoted to assistant engineer, afterwards being assigned in that capacity to duty on the Evanston track elevation at Evanston, Ill. In 1913 he became engineer of track elevation with headquarters at Chicago, and in 1915 was promoted to valuation engineer.

HERMAN F. SCHOLTZ, assistant chief engineer of the Newport Hydro-Carbon Co., the Newport Chemical Works, Inc., at Carrollville, Wis.,

has been commissioned as captain in the Engineer Officers' Reserve Corps.

W. J. HARAHAN, president of the Seaboard Air Line Ry., has been appointed Federal manager, with headquarters at Norfolk, Va. From 1886 to 1895 Mr. Harahan was in the engineering and maintenance departments of the Louisville & Nashville R.R., the Chesapeake & Ohio Ry., and the Baltimore & Ohio Southwestern R.R. In 1901 he was chief engineer of the Illinois Central Railroad.

PAUL O. KINGENSMITH, formerly bridge engineer for the State Highway Commission of Indiana, which was recently dissolved by the State Supreme Court, has become research engineer for the Indiana Public Service Commission.

H. A. CASSILL has been appointed engineer maintenance of way, Pere Marquette R.R., and will have jurisdiction as assistant in track maintenance and construction with offices at Detroit.

H. L. INGERSOLL, assistant to the president, New York Central R.R., has been appointed mechanical assistant to the Eastern regional director with headquarters in New York City.

MILO C. TAYLOR, of Folsom & Taylor, consulting engineers, Bloomington, Ill., and formerly city engineer of El Paso, Ill., has left his private practice to enter the service of the United States Shipping Board, Emergency Fleet Corporation, with headquarters at Philadelphia. He is engaged in highway improvements, sanitary, water supply and sewage work in connection with industrial housing development.

L. J. PUTNAM, who has been appointed chief engineer of the Chicago & North Western Ry., as mentioned in *Engineering News-Record* of last week, was born in Iowa in 1878 and was educated at Cornell College, Iowa. He entered the service of the Chicago & North Western Ry. in 1899, after a short period with the Illinois Central R.R. Starting as instrumentman, he was successively assistant engineer, acting division engineer, resident engineer and division engineer. His promotion to division engineer was in April, 1912, and in May, 1913, he became principal assistant engineer.

F. C. HUFFMAN, resident engineer, Chicago & North Western Ry., who was promoted to principal assistant engineer, succeeding L. J. Putnam, promoted to chief engineer, as mentioned in *Engineering News-Record* of last week, p. 1250, was graduated from Purdue University in 1905 and entered the service of the Pennsylvania R.R. in the engineering department. The following year he was employed by the Chicago & North Western as instrumentman and later was appointed assistant engineer on construction. In 1908 he became assistant state engineer of North Dakota, but returned to the service of the North Western as locating engineer in the following year, after which he became resident engineer of construction with headquarters at Chicago, having charge of grade reduction of the Southern Illinois division and the construction of the grain elevators at Milwaukee, South Chicago and Council Bluffs.

A. PEARSON HOOVER of the firm of Goodrich, Hoover & Bennett, consulting engineers, New York City, has been commissioned as major in the quartermaster corps, National Army, and assigned to duty in the construction division. As mentioned in *Engineering News-Record* of June 20, p. 1204, John W. F. Bennett of the same firm has also been commissioned as major in the construction division.

W. A. MURRAY, division engineer, Pennsylvania division, New York Central R.R., has been transferred to the Mohawk division. G. N. Edmonson, division engineer, Rochester division, succeeds Mr. Murray. J. W. Stevens, supervisor of track at Clearfield, Penn., becomes acting division engineer, Rochester division, succeeding Mr. Edmonson.

OBITUARY

LIEUT. ARCHIBALD ROBERTSON of the British Royal Engineers and formerly a civil engineer of Seattle, has been killed in action in France. Lieutenant Robertson left Seattle a few weeks after the outbreak of the war and enlisted as a private in a Canadian regiment. Later he was transferred to the Royal Engineers and won his commission through bravery in action in the first battle of Ypres. He was wounded in this action but returned to active service after a period of several months in a base hospital.

DR. JAMES DOUGLAS, former president and lately chairman of the board of directors of Phelps, Dodge & Co., copper mine operators and owners, died June 25 at his home in Spuyten Duyvil, New York City. Doctor Douglas, who was noted as a philanthropist as well as a mining engineer, had taken great interest in the activities of engineering societies, and in November, 1916, presented to the United Engineering Society $100,000, the income from which is to be used in the development and extension of the library. Doctor Douglas, who stood in the front rank of mining engineers, had been engaged in a constantly active career for more than forty years, principally in the mining and production of copper, although he also won acknowledgment of his ability as a railroad executive in the management of the El Paso & Southwestern R.R. He was 80 years old and was born in Quebec, Canada, and was graduated from Queen's College, Kingston, in 1858 and later from Edinburgh University, Scotland. For several years after graduation he served as professor of chemistry in Morrin College, Quebec. During that period, with the assistance of the late Dr. T. Sterry Hunt, he made a special study of metallurgical treatment of copper ores. These experiments led to the discovery of the Hunt-Douglas process, an important development in the modern methods in the metallurgy of copper.

Doctor Douglas came to the United States in 1875, at the age of 38, to take charge of the copper works at Phoenixville, Penn. About 36 years ago he became identified with copper industries in the Southwest and northern Mexico. He soon formed the nucleus of the great copper mining enterprises which, under his management, have taken place in the first rank of American industry. As president of Phelps, Dodge & Co., Doctor Douglas directed the management of the Copper Queen Consolidated Mining Co., the Montezuma Copper Co., the Detroit Copper Mining Co., the Burro Mountain Copper Co. and the Stag Canon Fuel Co. In 1887 he was made president of the Arizona & Northeastern R.R., and from July, 1901, was president of the El Paso & Southwestern R.R., which took over the Arizona & Southeastern and other lines in Arizona and which, in 1905, absorbed the El Paso & Northeastern. He was also president of the Nacozari Railroad.

He was a member and twice president of the American Institute of Mining Engineers. He was also the author of several books, among which are "Canadian Independence," "Imperial Federation and Annexation" and "Untechnical Addresses on Technical Subjects," and contributed extensively to the technical press.

LESLIE ABRAM WATERBURY, head of the department of civil and architectural engineering, University of Arizona, died June 15 at Nitro, W. Va., where he was engaged in the construction of the explosives plant there. Mr. Waterbury was graduated from the University of Illinois in civil engineering in 1902 with the degree of B. S., and since that time has taken three other degrees from the university. On June 12 last he received the professional degree in architectural engineering. In September, 1902, he became instructor in mathematics and civil engineering at Michigan Agricultural College, and in 1903, after brief employment with the Scherzer Rolling Lift Bridge Co. became instructor in civil engineering at the University of Illinois. Later he entered private practice and in 1917 became professor of civil engineering at the University of Arizona at Tucson. Professor Waterbury was born in Polo, Ill., in 1880.

NEWS OF ENGINEERING INDUSTRIES

FOR MANUFACTURERS WHO SERVE ENGINEERS AND CONTRACTORS

America First in World's Export Trade

Lead To Be Maintained After the War by Largest Merchant Marine and Will Stabilize Industry

Practically one-half of the world's export trade, amounting to $8,000,000,000, was supplied by the United States in 1917. In 1913 Great Britain stood first, Germany a close second and the United States third. Now it stands in the first place with a manufactured export trade figuring at more than $4,000,000,000; Great Britain second with more than $2,000,000,000, which, owing to the higher prices due to the war, actually represents less goods shipped than in the 1913 record. America's lead in trade will probably be increased as the shipbuilding program proceeds. The 88,000 tons of shipping delivered in January was increased 300% by May, and Edward N. Hurley, chairman of the Shipping Board, reports that the production by the end of the year will be 500,000 tons per month. This will make a total for the year of 3,500,000, in addition to the ships already in commission. By the end of next year there will be 9,000,000 more and by 1920 a total of 25,000,000 tons will be in commission. Since it takes about 2.5 tons of shipping for each United States soldier at the front it will require 12,500,000 tons to support an army of 5,000,000.

The Webb-Pomerene bill permits combinations for foreign trade to meet the competition of the great commercial trusts of the European countries. Such trusts are still being formed in Germany in spite of the war. One of the most recent is a "Corporation for Domestic and Foreign Commerce," a combination of bankers, steamship companies, coal, metal, manufacturing, shipping and planters' interests, for the building and operation of railways, electric plants, factories, mines, irrigation, ore and oil fields and plantations.

England has made a study of the maintenance of essential industries, recovery of trade, new markets, development of native resources and prevention of their falling into foreign control, and France has sent out delegations from her industries. One is now visiting Australia to encourage trade between the two countries.

In order to bring all these facts before the manufacturing public, associations are holding meetings in various parts of the country. They assert that the great stabilizer for the industries after the war will be a large foreign trade carried in our own merchant marine. At a recent meeting of the National Conference of State Manufacturing Associations at Albany, N. Y., Representative N. J. Gould pointed out the English and German plans for post-war commerce, and offered a resolution to authorize the appointment of a representative of that body to confer with the various national commercial and manufacturing associations for the purpose of uniting and coöperating with one another and with the Federal Government.

Although the close combination for foreign trade authorized by the Webb-Pomerene foreign trade act would be illegal in domestic trade, the law was framed to permit such combinations for foreign trade under the control of the Federal Trade Commission. It is required that registry of names, places of business or office, list of officers, direc-

(Concluded on page 64)

Eighty-Acre Munition Plant to be Erected in Chicago

A munition plant covering 80 acres is to be built in Chicago, for the Symington Co. by the Thompson-Starrett Co. The main building will be U-shaped, of mill construction and will be 2400 ft. long containing a machine shop 1240 ft. x 250 ft. It will also contain a shell shop 1200 ft. x 300 ft., the daily capacity of which will be 10,000 three-inch shells. The plant will be completed in November.

Building Trades Will Organize at Atlantic City Meeting

The building trades will meet at Atlantic City, July 15-16, at the call of President Harry A. Wheeler of the Chamber of Commerce of the United States, to form a War Service Committee.

The sessions will be opened by a speech by President Wheeler. The business of the meeting will be to "coördinate assistance to the Government during the war" and to "reëstablish and maintain the general prosperity of the industry." If the organization of a permanent War Service Committee is postponed, an immediate and temporary committee will be appointed. Each organization is urged to send several representatives and to name a prominent business man as a delegate to serve on such a temporary committee.

After the organization is perfected a War Service Committee which, it is said, will speak for the entire industry will be formed. Those intending to participate may make arrangements with Allen Walker, Chamber of Commerce of the United States, Woolworth Building, New York City.

New Aid to Employers in United States Employment Service

Maximum assistance to employers is the object of the establishment of an inquiry office by the United States Employment Service. The office will give full information regarding the procuring of help, from common laborers to men of highest technical attainments. Records of labor surplus and shortage, laws and court decisions affecting labor, naturalization and immigration are kept. Activities of industrial plants to reduce labor turnover as well as statistics on wage scales and cost of living are other lines of information obtainable from the office.

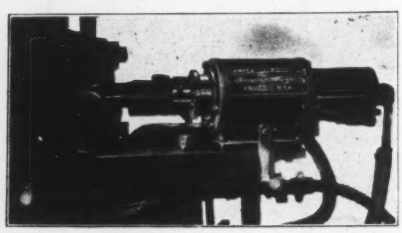
The address is Inquiry Office, United States Employment Service, Department of Labor, Washington.

Bridge and Structural Output Two-Thirds Contracted For

Further evidence of the demand on the steel production of the country is seen in the records of the Bridge Builders' and Structural Society, showing that during the month of May, 60% of the entire capacity of the bridge and structural shops of the country was contracted for. In August, 1917, the steel industries made an estimate of 4,000,000 tons as the requirement of the United States Government for the current year.

Compact Steel Drill Puncher

The puncher shown in the accompanying illustration is a compact pneumatic device designed to open a hole in the end of a piece of drill steel while being worked into a bit, collar or lug. The punch is held in a tappet chuck with a hammer set in an air-feed cylinder which permits the punch to be



DEVICE FOR PUNCHING DRILL STEEL

simultaneously hammered and fed forward into the steel when opening a water hole. The action of the hammer and air-feed cylinder are controlled by a single handle, and the whole device may be mounted separately or adapted to other sharpeners. It is made by the Denver Rock Drill Manufacturing Co., Denver, Colorado.

More Lumber Included in Export Conservation List

In a notice sent out by the War Trade Board dated June 28, the following lumber and manufactured wood items are added to the export conservation list of May, 1917: Round, sawed, sided or square logs; manufactured lumber in all dimensions, and sizes for commercial users, including walnut, mahogany or birch wood cut for parquet flooring or wood suitable for gun stocks, airplane propeller blades and other war uses; partly manufactured articles of an unfinished shape that are to be completed into finished articles at the point of destination.

The falling off in lumber production to the extent of 10 per cent less than that in 1916 is reported by the forest service, United States Department of Agriculture.

This is attributed principally to decreased private building operations, scarcity of labor, transportation difficulties, curtailment in the wood-using industries and general dislocation of the industry.

Royalties on Railroad Specialty Patents to Be Allowed

Royalties usually allowed to patentees of railroad and other manufacturing specialties will, in the future, be allowed by the railroad administration, according to information recently received.

Recent proposals by the railroad administration, that royalty rights on material used in Government orders for cars and locomotives should be relinquished, brought forth protest from many sections. The manufacturers informed the administration that in their opinion such action would kill the initiative in which inventions arise.

Allied Publicity Bureau Completes Tour of Manufactories

A tour of inspection of the plants of the manufacturers represented in the conference with the Allied Publicity Bureau of Cleveland followed the conference in Chicago, June 17. The tour ended in Cleveland June 28.

The plants visited were the Western Wheeled Scraper and the Barber Greene Co. at Aurora, Ill.; the Clyde Iron Works and the Carbic Manufacturing Co. at Duluth, Minn.; the Parsons Co. at Newton, Iowa; the C. H. and E. Manufacturing Co., Inc.; the Milwaukee Concrete Mixer Co. and the Sterling Wheelbarrow Co. at Milwaukee, Wis.; the Marsh-Capron Mfg. Co. and the Austin Mfg. Co. at Chicago, Ill.; the Cleveland Welding Co., the Lakewood Engineering Co. and the Hydraulic Pressed Steel Co. at Cleveland, Ohio.

At each of the plants an informal meeting was held for discussion of sales and advertising problems.

D. H. Nichols, managing director of the Allied Publicity Bureau, conceived and carried out the idea of the trip.

Advanced Railroad Rates Will Probably Have Slight Effect on Material Prices

Iron Ore, Steel, Cement and Lumber Receive Consideration—Volume of Normal and War Building Work Compared

The effect of the new railroad rates on prices has occupied most attention during the past month, and, as expected, has caused an upward movement, though slight. The effect on cement, for instance, will be 8c. per barrel. Assuming 1½ bbl. per cubic yard of concrete, it will make an advance of but 12c. per yard. If the gravel and sand are hauled by rail, add about 60c. per yard, making 72c. per yard total. The advance in steel for reinforcing would amount to hardly more than 1c. per cubic yard of concrete, so that the whole effect is negligible.

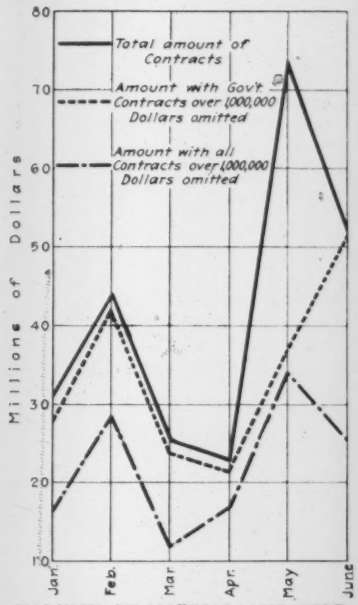
Cement and steel have been subjects of recent conferences at Washington, cement being continued on the priority list until Aug. 1. The uncertainty of the fuel situation prevented extending the period beyond that time.

An agreement of an advance of 45c. over the present price of $5.05 per gross ton f.o.b. lower lake ports for iron ore was also reached at Washington. The price of steel will be the same until Sept. 30.

The copper interests have been anxious for a revision of the 23½c. per pound, but so far no action has been taken.

The lumber interests of the Northwest report that although the rates will increase the cost slightly it will not affect their market, as the differential will be the same. Douglas fir in Chicago will advance from $16.50 per thousand to $18 per thousand and Southern pine from $7.95 to $9.45 per thousand. Heavy buying by retail dealers in anticipation of the rise in freight rates has occurred, causing a rise in prices and great depletion of stocks at the mills. Still higher lumber prices have been prevented by the price fixing committee taking them under advisement. This is probably the beginning of the fixing of all the building material prices.

Compiling certain amounts of contracts for buildings that have been let since the beginning of the year and plotting them by months, as in the accompanying diagrams, shows a peak in May. The solid line gives the total figures, but assuming that those contracts of $1,000,000 and over are unusual, and deducting them from the totals, the bottom line results. This shows the operations among the average con-



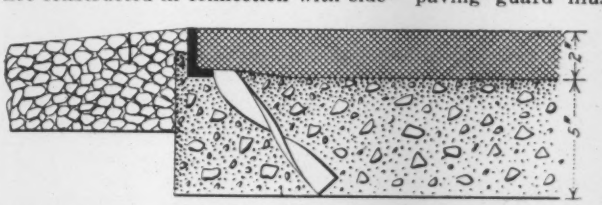
VOLUME OF NORMAL AND WAR BUILDING WORK

tracts and it is noted that from March to April there was a falling off of the totals but an advance in the amount of average contracts. Otherwise, the bottom line fluctuates about the same as the total line. The intermediate line represents the difference between the total and Government contracts alone that have been $1,000,000 and over.

Highway Paving Guard Formed by Anchored Steel Angle

To supply a rigid guard to secure the edges of paving against movement or disintegration from traffic on bituminous, brick or block roadways that are not constructed in connection with sidewalks, the device shown in the accompanying cut has been used.

Other methods employed have been to pave up to loose stone shoulders or to extend the concrete base on the edges up to the surface level of the pavement, forming a small concrete edging. The paving guard illustrated is a special steel angle having a continuous bearing on the base, being securely anchored at intervals into the edge of the base. It is manufactured by the International Steel Tie Co., Cleveland.



ANCHORED STEEL ANGLE FORMS PAVING GUARD

America Leads in Export Trade

(Concluded from page 62)

tors and stockholders, with copies of articles of incorporation or agreement be made and information regarding organization, conduct of business, etc., must be furnished whenever the commission may require.

The industries that unite will form a central export company to handle foreign selling and its problems, and will have a competent managing force, offices and equipment. It will act as a clearing house for shipping, financial, credit and other matters, gather all information obtainable from the United States and foreign departments of commerce.

Must Study Conditions

At the present time the United States is the only country in position to supply many articles needed by foreign countries, and that we shall reap the advantage of this temporary condition only from the attention given this trade and upon the establishment of a feeling of good will on the part of our foreign customers, was pointed out by Consul T. C. Davis of Grenoble, France. He added that, if the customers' necessities are properly handled at the present time, there is certain to be increased business. He stated further that American exporters must not be indifferent to the buyer's methods of doing business, and should quote prices in money, weights and measures with which he is familiar. Germany would have been absolutely supreme in South American markets in less than 20 years and the reason lies in the fact that the Germans adapted their merchandise to the wishes of the purchaser, facilitated the purchaser's credit and gave longer time in their drafts, quoted prices and quantities in terms of the country in which they dealt, and used the metric system, all of which the South American appreciated.

Although such action is comparatively recent, the financial interests of this country are providing American banking facilities throughout the world, especially in South America. The first branch bank was established in Buenos Aires, Argentina, about five years ago. Now one bank has twelve branches in eastern and western South America, and another corporation, representing a number of the largest banks in the greater cities of the United States, is opening banks in competition with the first.

Foreign markets are opening. A recent commerce report says that an American trench-digging machine has been shipped to Scotland for trial. European markets for brick-making machines, also given in recent commerce reports, include Denmark, Netherlands, Spain, Switzerland and Greece, and a demand for American lumber has arisen in China, due to a shortage of the Japanese supply on account of existing difficulties and the high prices of Japanese labor.

The Italian lumber demand has been mentioned in a previous issue, and F. T. F. Dumont, American consul at Florence, suggests that American manufacturers begin to exhibit wood samples in Italy, submitting several qualities of each variety, with prices. The great requirement is to have samples of American woods in Italy now, so that dealers may see just what the United States can furnish in the way of cheap lumber. And in this connection it is noted that the Italian Government is already studying the proposition of organizing an international sample fair.

Pointing out the paramount financial economic and constructive problems that will arise after the war, and having in mind these factors of trade possibilities, Arthur Reynolds, vice-president of the Continental and Commercial Bank of Chicago, in addressing members of the Bankers' Club said, "After ships are no longer needed to carry soldiers, munitions and food to our allies and our army in France, what are we going to do with the ships we are building? We shall lose a golden opportunity if we sit supinely by and do nothing while other countries make plans for world commerce."

Lime Association Officers Elected at Annual Meeting

The Lime Association, a body recently organized at Cleveland, Ohio, to coördinate the activities now carried on by the Hydrated Lime Bureau, the Agricultural Lime Bureau, the Lime Service Bureau, and similar bodies, has elected W. E. Carson, of the Riverton Lime Co., as president, C. W. S. Cobb, of the Glencoe Lime Co., as treasurer, and a board of directors composed of 14 members. The secretary-manager is to be appointed by the board of directors in the near future.

The meeting was adjourned from Cleveland to Washington for the purpose of holding a conference with the War Industries Board.

A war service committee was organized, with headquarters at Washington, to work with the board.

It is stated by the association that this organization is in no sense a combination of manufacturers, its purpose being similar in nature to that of the Portland Cement Assn., Yellow Pine Assn., Metal Lathe Assn., and many other similar associations.

The various activities carried on by the organizing companies or bureaus will be placed under the direct management of the general association, and are to become departments such as construction, agricultural, product standardization and uniform cost accounting, to meet the desires of the Government and bring about the general betterment of the industry.

Business Notes

James T. Lind, of Detroit, Mich., has been appointed Director of the Bureau of Gas Plants in the fuel administration. Mr. Lind is considered an authority upon subjects relative to the gas industry, and will have supervision of the regulation of the artificial gas industry, in so far as it affects the consumption of fuel.

C. C. Hanch, formerly treasurer and a director of the Studebaker Corporation, has been appointed chief of the automotive products section of the War Industries Board, to succeed H. L. Horning, resigned.

Max Thelen, of San Francisco, has been appointed by Secretary Baker to be supervisor of war contracts under Quartermaster General Goethals. Mr. Thelen is to be in the office of Brig. Gen. Hugh S. Johnson, and will have complete control of contracts, acting in coöperation with Assistant Secretary of War Stettinius.

Trade Publications

Concrete mixers and contractors' machinery are the subjects of a new 60-page catalog of the Waterloo Cement Machinery Corporation, Waterloo, Iowa. Mixers and hoists occupy 42 pages, the remainder dealing with machinery for general contracting work.

"Wheeler-Balcke Cooling Towers" is the name of Bulletin 109-B, just published by the Wheeler Condenser & Engineering Co., Carteret, N. J.

"Sullivan Rotators" type "DP-33"; "DR-33" and The Sullivan "DR-6," mounted water hammer drills, are the subjects of Bulletins 70-F and 70-H issued by the Sullivan Machinery Company, Chicago, March and April, 1918, respectively. They give complete descriptions and illustrations of the mining machinery noted.

"Tarvia-KP" is the title of a vest pocket reference booklet issued by the Barrett Co. showing each step in cold patching a road with that material.

The Ingersoll-Rand Co., 11 Broadway, New York City, recently issued Form 4039, an eight-page bulletin on the Leyner shank and bit punch for punching out holes in bits and shanks of hollow drill steel; and Form 901, a four-page bulletin showing the line of "Little David" pneumatic tools. Tables of sizes and capacities are given.